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A FACTORY POWER PLANT

SMALL STEAM PLANT WITH COMPLETE AUXILIARY EQUIPMENT

BY CARL S. DOW

IN the design of a power plant it is customary to place a limit on the size at which it is economical or desirable to install certain auxiliaries or apparatus. In other words, it is generally understood that a very small plant should not have mechanical draft, or an economizer, or a condenser, or compound or triple expansion engines. Where to draw the line must be determined by the conditions, not by an arbitrary ruling, for in this, as in other work, "circumstances alter cases." Certain auxiliaries require the care of skilled engineers, and the initial cost and expense of operation of small sizes is often so great that no appreciable economy results from their use. This argument, however, does not hold when there are skilled engineers about the industrial plant, or when the company owning the plant builds the apparatus in question.

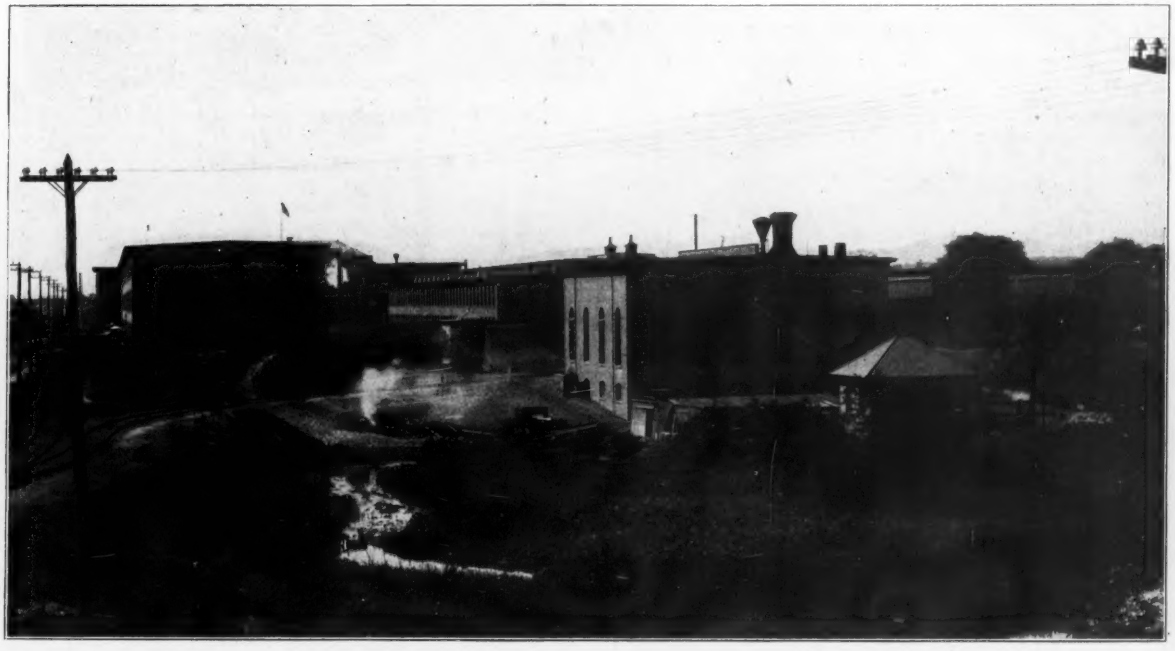

FIG. I. FAN AND MACHINE SHOPS, POWER HOUSE AND FOUNDRY OF B. F. STURTEVANT CO.

The power plant of the B. F. Sturtevant Co. presents many interesting features, the more interesting because the small plant is equipped with apparatus

often found only in large stations. Also the various uses of the steam are of interest, for some of it goes to the generating sets for lighting and power, some is required for heating the shops, which have a floor space of 9 acres, and some steam is required for testing the engines, generating sets, steam fans, and turbines.

The Building and Location

The power house is of brick, about 80 ft. square,

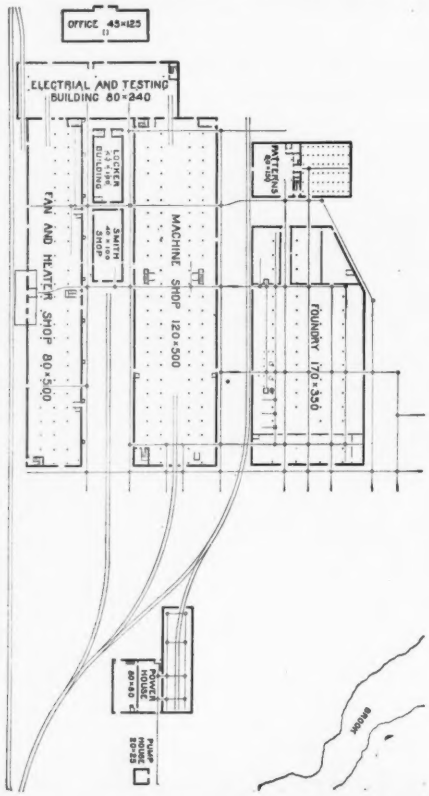

FIG. 2. PLAN OF WORKS

and located near the bank of a brook which supplies an abundance of good water for the boilers and condensers. As this brook is at some distance from the factory building, the steam and power distribution is made through underground tunnels and trenches. The main tunnel extends from the power house direct to the testing building, with cross-connecting tunnels and trenches for conducting steam to the other buildings for heating purposes. The concrete tunnel also carries the wires for electric lighting and power, and, also, the compressed air pipes. Both power and light are carried on a 220-v. circuit, direct-current. The heating system in each shop consists of an engine-driven fan which draws air through a heater made up of steam pipes, and forces it to all parts of the building. Different systems of distribution are employed in the various shops.

For testing the steam machinery, provision is made at the test plate for connections of various sizes to supply the engines being tested. By means of proper connections and reducing valves, steam may be had at the proper pressure at any point on the test plate. Since many of the generating sets are for government work, an independent surface condenser is installed at the test plate so that the required vacuum may be maintained and the water consumption easily measured.

The Boiler Plant

Coming now to the power house we find on one side of the fire wall, which divides the building in two parts of practically equal size, 4 Stirling water-tube boilers, of which 3 are 250 h. p., and one is 325 h. p.

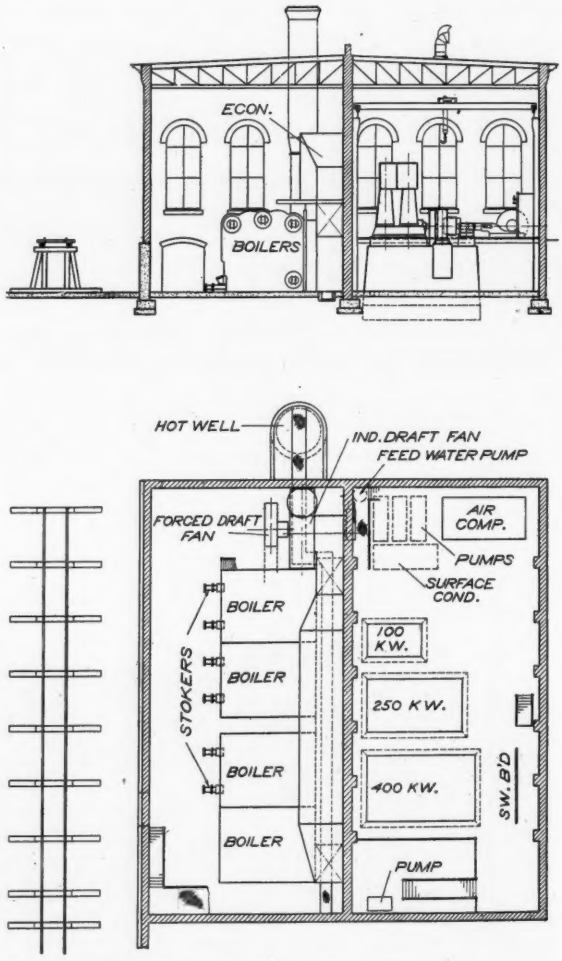

FIG. 3. PLAN AND ELEVATION OF POWER PLANT

It is usual to have 150 lb. pressure upon 3 of these boilers, 1 boiler being idle for cleaning and repairs. The plant has a capacity of 1075 boiler h. p., while only 750 h. p. is usually required. The 325- h. p. boiler has Foster shaking grates and is hand-fired, while the other 3 are provided with Jones' underfeed stokers.

Since the B. F. Sturtevant Co. manufactures apparatus for mechanical draft, the stokers are served by an undergrate-draft fan 6 by 3½ in., driven by a 7 by

7 in. vertical engine. This fan discharges air to the ashpits, maintaining an average pressure of 2 in. of water. An induced-draft fan, located above the boilers, draws the hot gases from the boilers through an economizer and discharges them into a short stack extending just above the roof. Arrangement of steel-plate flues is such that the gases may be bypassed to the stacks in case the economizer needs cleaning or repairs. The suction at the boiler side of the economizer averages about 1 in. water gage and at the stack side 1½ in.; thus the economizer imposes a resistance

FIG. 4. BOILER ROOM WITH CAPACITY OF 1075 H. P. IN 4 UNITS

which is equal to practically ½ in. of draft. Both the undergrate-draft fan and the induced-draft fan are equipped with Flynn automatic regulators so that the speeds of the fans are varied to satisfy the conditions. The mechanical draft permits the use of any kind of fuel, and the coal consists of one-half bituminous and one-half anthracite screenings.

Heating the Feed Water

The economizer consists of 52 sections of 10 pipes each or 520 pipes which measure 6458 sq. ft. of heating surface. The economizer will hold over 16 tons of water, thus storing a supply of hot water that will last the boilers for about 1½ hr., assuming that 750 h. p. of boilers are in operation. This storage capacity is of great advantage for fluctuating loads. The gases on leaving the boilers average practically 600 deg. F., and are cooled by the economizer to 320 to 340 deg. In cooling, the gases give up a large quantity of heat, which is shown by the fact that the water is heated from about 205 to 350 deg. The boilers simply supply the latent heat, thus they are "steam generators" not combined "feed heaters and steam generators."

The feed water is taken from the hot well, which is supplied largely by the overflow from the air pump of the condenser. Added to this is the condensation from the heating system, which is returned from the heaters in the shops through the tunnel to the hot well; also the drips from the various auxiliaries that run noncondensing are piped to the hot well. The water is taken from the hot well by a pump and forced through a closed heater in which the temperature is raised from about 120 deg. (average temperature in the hot well) to about 205 deg. These average temperatures provide means of calculating the relative amount of heating done by the heater, economizer and boiler. On the average, the boilers contribute 75 per cent of the heat, that is, of the total heat required to convert the cold water from the brook into steam, the boilers furnish 75 per cent. The economizer furnishes about 12 per cent, and the heater about 7½ per cent, while the balance, the 5½ per cent, indicates the amount of heat in the water coming from the condenser.

Power Room

Upon the other side of the fire wall are the generating sets, condensers, boiler feed pumps, and air com-

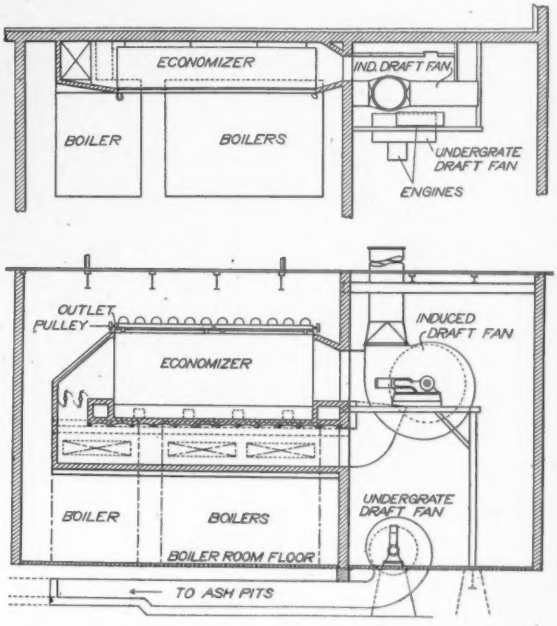

FIG. 5. ECONOMIZER AND FAN ARRANGEMENT

pressors. The condenser is of the surface type with independent air and circulating pump, and contains 2000 sq. ft. of cooling surface. The air compressor, built by the Laidlaw-Dunn-Gordon Co., is of the horizontal cross-compound type with Meyer valve gear. The cylinders measure 11 by 18 by 8 by 11. The air compressor furnishes the air at about 90 lb. pressure for the various shops; among the uses being the current of air for cleaning chips out of various machine parts in the machine shop, the sand blast in the foundry, blast for the rivet forges, and pneumatic hammers in the fan shop, compressed air hoists, in the printing

department for cleaning the dust from type cases, and in the advertising department for operating the air brush for retouching photographs.

In the power house there are now three vertical compound generating sets of 100, 250, and 400 kw. capacity. These sets, operated together or singly, according to the demand for light and power, supply the entire current which is distributed to motors within the shops, both the individual and the group drives being used, according to conditions.

Engines

The 100 kw. set is of the vertical compound type with cranks at 180 deg. This set is of high speed, the large diameter and short stroke giving large power in small space, and high rotative speed with moderate piston travel. In fact, this type is extensively used in the United States Navy for electric lighting, and fulfills the rigid government specifications. The engine has a piston valve for the high-pressure cylinder, and a balanced slide valve for the low-pressure. It runs at a speed of 350 r. p. m., and even at this speed there is no vibration. The accompanying photograph, Fig. 6, showing the 3 sets, was given a 5-min. exposure while the 100 kw. set was in operation. That there is no vibration is shown by the sharp lines on the negative, each cord of the field coil insulation being sharply defined. Being an enclosed engine, one cannot tell from the picture whether or not it is running.

The 2 large generating sets are of the cross-compound type with cranks at 90 deg. The cylinders are provided with 4 cylindrical openings for the valves, a construction which permits the removal of cylinder heads without altering the adjustment of the valves. These valves, which are of the gridiron type, are placed horizontally and driven by levers and rockers from the eccentric. The admission valves, of which there are two, one for each end, consist of a main valve driven by the eccentric on the shaft. Sliding on the face of the main valve is another gridiron valve driven by the governor and controlling the cutoff. This valve gear, having numerous ports for rapid admission and exhaust, contributes to high economy because the cutoff can be adjusted without in any way altering the admission. The exhaust valves are like the steam valves except that there are no auxiliary valves.

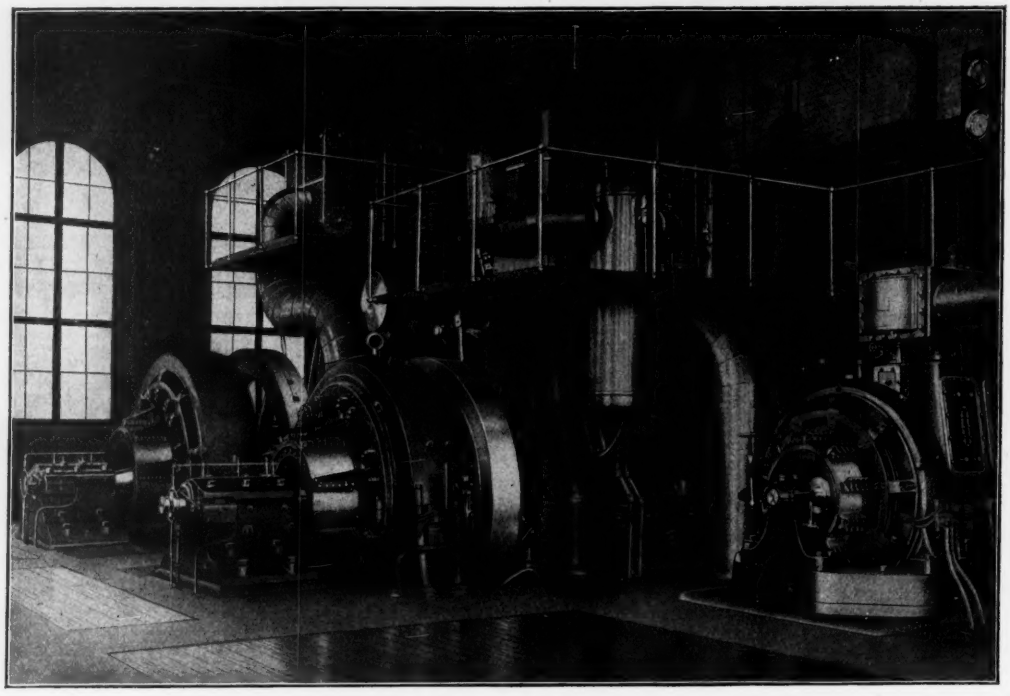

FIG. 6. INTERIOR OF ENGINE ROOM

These engines are entirely enclosed, thus protecting the reciprocating parts from dirt and accident; and are provided with a system of forced lubrication which is positive and automatic. A small independent steam pump forces the lubricating oil through the crank shaft, web, crank pin, and connecting rod supplying the crank pin and the crosshead pin. Other pipes and passages lead to the crosshead guides, eccentric, etc., and also to the outboard bearing of the generator shaft. Since a pressure of 10 to 20 lb. per sq. in. is maintained in this system, the lubrication is so abundant that friction is reduced to a minimum, and the adjustable parts need be taken up only at long intervals.

Generators

The generators are of the 10-pole type designed for sparkless operation over a remarkably wide range of

load. Like the engines, they give no trouble even with the minimum amount of attention. Ample cooling surfaces and mechanical ventilation combined with low current densities in all conducting parts, result in a machine free from heating and burnouts even under severe conditions. They are capable of carrying an overload of 50 per cent for 2 hr. without sparking.

To the cast-iron magnet frame are bolted the pole pieces built up of soft steel punchings, which are so formed as to minimize field distortion due to armature reaction, and the pole horns give a perfect distribution of the magnetic flux so that the plane of sparkless

FIG. 7. STEAM VALVE OF 400 KW. UNIT

commutation is constant. The poles are fastened by 2 bolts each, the nuts being placed in pockets to allow a lateral movement of ½ in., a construction which facilitates the magnetic centering of the armature.

The armature is of the iron-clad, drum-wound type with the coils embedded in open slots. The core is built up of soft steel punchings, which are mounted on a cast-iron spider and clamped between end flanges. The armature is multiple wound and provided with cross-connecting rings on the back end so that all brushes of the same polarity are maintained at the same potential. The resulting equality of pole strength is of great importance for large direct-con-

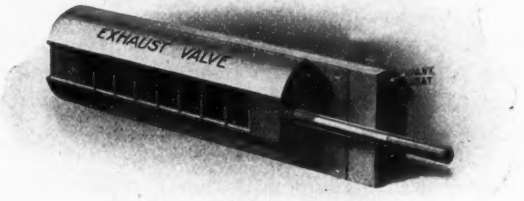

FIG. 8. EXHAUST VALVE

nected generators, as there is no trouble from sparking or unbalanced magnetic pull. For a machine of this size it is desirable to reduce to a minimum the necessity for turning off the commutator. This is accomplished by carefully selecting the mica and making the commutation practically perfect.

The method of supporting the brushes is somewhat different from the usual practice of generators of this size. The brush holders are not mounted on a round stud, but are clamped directly against a composition frame, which is supported by and insulated from the brush ring itself. Each brush is, therefore, separately

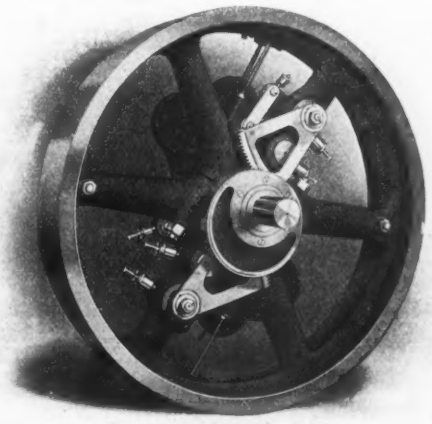

FIG. 9. TYPE OF GOVERNOR USED ON VERTICAL COMPOUNDS

adjustable and removable. The brushes may be adjusted by rotating the entire ring by means of a hand wheel.

SCALE PREVENTION IN BOILERS

Discussing this subject before the New England Street Railway Club, Professor Walker, of the Massachusetts Institute of Technology, advocated the purifying of water by regular treatment before it enters the boiler. A lot of soda should not be pumped in once a day, but the treatment should be continuous, the reducing chemical being added to the water before it goes into the boiler so that the scale forming material will, so far as possible, be prevented from attaching itself to the shell.

In the discussion of this paper the matter of the action of zinc in boilers was taken up and the consensus of opinion was that this serves to prevent pitting but not scale; that almost any kind of zinc, if well distributed in various places through the boiler, will stop this pitting, but that the zinc should have good eelctrical contact with the shell of the boiler. Cases were given where pitting had taken place even where zinc was in use, but this was thought to be due to an insufficient amount of zinc.

In regard to kerosene, the opinion was expressed that it has an action but is not very effective. If put in when the boiler is cool it will creep behind the scale so that when the boiler is heated and expands the scale will chip off to a certain extent, but if the scale is very dense so that the oil cannot work through it, this chipping will not occur. Kerosene was not thought to be good for preventing scale, only for removing it; pure kerosene was stated not to produce pitting, but if any animal oils are introduced the fatty acids and glycerine are likely to produce pitting.

POWER PLANT RECORDS AND ACCOUNTING

By J. G. Ould

THE planning of a system for the business of operating a power plant is much like getting a suit of clothes. It is possible for you to go to the store and see a suit which you like as to its cut and appearance, and when tried on find it a good fit; but the chances are that it would be the other way about and it would have to be pulled out here, drawn in there, and altered somewhere else before it could be made to fit your particular style of anatomy. So with

THE SUBURBAN R . R . CO.

DATE — BOILER HOUSE LOG — WATCH 8 A.M. TO 4 P.M.

BOILERS					COAL	ASH	FEED WATER METER	TEMPERATURES
1	2	3	4	5				OUTSIDE
								BOILER ROOM
								COLD WATER
					FEED PUMPS		MAKE UP METER	HEATER OUTLET
					1	2	3 4	ECON. OUTLET
								STACK
					REMARKS			FIREMAN
								COAL PASSER

FIG. 1. SAMPLE RECORD FOR BOILER ROOM

a system. To have it right, it must be built to order, and even then it may be the better for a change once in a while. The thought underlying this is, one cannot make a system by the yard and cut it off as required by different people.

System may be defined "as that method of doing work whereby the required results are obtained with the greatest efficiency and least expenditure of labor." It is possible, however, to have such a complicated system that it defeats its own ends; therefore, it should

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DATE — ENGINE ROOM LOG — WATCH 8 A.M. TO 4 P.M.

HR.	ENGINES			PRESSURES				COND.			PUMPS			REMARKS
	1	2	3	REC.		VACUUM		1	2	3	1	2	3	
				1	2	1	2	3						
														ENGINEER
														OILER
														HELPER

FIG. 2. KEEPING TRACK OF ENGINE PERFORMANCE

be as simple as one can make it for the purpose in hand.

The question of interest on the investment, depreciation and other fixed charges may or may not be in the province of the operating engineer, depending on circumstances. Although the operating department has a very great deal of interest in the depreciation account, since it depends in very large part on it as to the amount to be yearly charged off. If the machinery is not properly cared for, it certainly will wear or tear out much quicker than if carefully attended to. The operating department is concerned for the most part in supplying power at the smallest possible cost per unit and at the same time giving the best possible service.

By way of illustration let us suppose a suburban power station, giving out direct current for trolley and lighting service, to have a capacity of 3500 k. w., this in engines and a turbine direct connected to generators. The engines have jet and the turbine surface

THE SUBURBAN R . R . CO.

DATE — ELECTRICAL LOG — WATCH 8 A.M. TO 4 P.M.

HR.	AMPERES		SYSTEM	POWER		LIGHT		STATION		REMARKS
	GEN. 1	GEN. 2		LINE 1	LINE 2	LINE 1	LINE 2	PWR.	LGT.	
										ELECTR.
										HELPER.

FIG. 3. ELECTRICAL LOG

condensers with steam driven auxiliaries. Water is taken from a river.

I give the above data since a description of a plant such as this has just been given me, and there are many such plants throughout the country, so what applies to this may help more than one. Supposing we are to take charge of such a plant, to operate it. What sort of a scheme is best to get in close touch with it and its needs?

One of the most important things to know is what each piece of machinery does, for how long, at what efficiency in comparison with standard work; also with reference to other apparatus of the same sort in the plant. To keep track of these things a series of printed blanks are needed. It depends on the size of the plant and the number of hours it is operated as to whether it is best to have all the data on one sheet or on several. In the one in question, there are so many items it would seem best to have several blanks, each one for a special purpose. The plant being operated 24 hr. per day, with 3 watches, it is a matter of choice

as to whether it is best to put all the data for the day on one sheet or to have a separate sheet for each watch.

Boiler Room Record

Let us begin with boilers. Figure 1 will serve as an illustration. An X mark under the boiler number shows it to be in use, A—that it was shut down in that watch. The time may be indicated under the mark, or in the place for remarks. Coal ought always to be weighed. The blank can be arranged to have the weights as weighed, or only the total for the watch, as in the illustration. An ordinary school slate

The record also shows the number of hours each boiler is in use, and insures that they are used in proper turn. If it was noticed that No. 1 feed pump was used only half as often as the others, it would be a sign that it needed attention.

A register of the amount of "make up" for the feed is often of value in pointing out trouble; for if your load is about as usual and your make up goes higher than usual, you possibly have a leak somewhere, perhaps in the closed heater some of the tubes are leaking.

If the make up meter shows much less, it may be that the tubes of the surface condenser are leaking and

DATE		MONTHLY DATA OF STEAM & ELECTRIC PLANT			
COAL, LB 000000	000.00 NET TONS	COST OF COAL AT 0.00 PER TON	.000	00	
ASHES, " 000 CANS 00000	.00.00	" " ASH REMOVAL	000	00	
" % TO COAL BURNED.....	.00.00	" " OIL	.0	00	
COAL USED 1907	.00.00	" " PACKING	.0	00	
" " 1908	.00.00	" " WASTE	.0	00	
DIFFERENCE IN FAVOR OF:- 1908	.00.00	" " GENERAL SUPPLIES	.0	00	.000 00
DAYS UNDER STEAM 1907	.00.00	SALARIES	00	00	.000 00
" " 1908	.00.00	TOTAL FOR THE MONTH:-			.000 00
AVERAGE COAL PER DAY 1907	.00.00	TOTAL COST, MARCH 1907			.000 00
" " " " 1908	.00.00	DIFFERENCE IN FAVOR OF:- 1908			.000 00
DIFFERENCE IN FAVOR OF:- 1908	.00.00	COST PER WORKING DAY 1907	.00	00	
FEED WATER 1907	000.00	" " " " 1908	.00	00	
" " 1908	000.00	DIFFERENCE IN FAVOR OF:- 1908	.0	00	
DIFFERENCE:-		COST OF COAL MARCH 1907 - AT $ 0.00 PER TON			.000 00
FEED WATER PER DAY 1907	.00.00	COST OF COAL MARCH 1908 - AT $ 0.00 PER TON			.000 00
" " " " 1908	.00.00	DIFFERENCE IN FAVOR OF:- 1907			.00 00
DIFFERENCE					
FEED PER LB. OF COAL 1907	.00.00	COST OF COAL TO EVAPORATE - 1000 LBS. OF WATER		00.00	CTS.
" " " " 1908	.00.00	COST OF ASH TO EVAPORATE - 1000 LBS. OF WATER		00.00	
DIFFERENCE IN FAVOR OF:- 1907	.00.00	TOTAL COST PER 1000 1908		00.00	
FEED PER LB. OF COMBUST 1907	.00.00	" , PER 1000, MARCH 1907		00.00	
" " " " 1908	.00.00	DIFFERENCE IN FAVOR OF:- 1908		00.00	
DIFFERENCE IN FAVOR OF:- 1908	.00.00				
WATER, CU. FT. USED 1907	.00.00	GAS 1907			.00 00
" METER 1 0000		GAS 1908			.00 00
" " 2 0000 1908	.00.00	DIFFERENCE IN FAVOR OF 1907			.0 00
DIFFERENCE IN FAVOR OF:- 1907	.00.00				
WATER PER DAY 1907	.00.00				
" " " 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1907	.00.00				
MAKE UP METER 1907	.00.00				
" " " 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1908	.00.00				
MAKE UP PER DAY 1907	.00.00				
" " " 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1908	.00.00				
GAS, CU. FT. 1907	.00.00				
" METER 1 0000					
" " 2 0000 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1907	.00.00				
GAS, PER DAY 1907	.00.00				
" " " 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1907	.00.00				
PUMP COUNTERS 1907	.00.00				
" PUMP NO. 5 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1908	.00.00				
COUNTER PER DAY 1907	.00.00				
" " " 1908	.00.00				
DIFFERENCE IN FAVOR OF:- 1908	.00.00				
ICE CANS 1908	.00.00				

FIG. 4. MONTHLY RECORD FOR POWER PLANT

ruled with a scriber or the point of a knife, is a good tally sheet for the fireman to use when weighing coal or ash, the total from the slate being put on the blank.

Ash cannot well be weighed for the reason that it is more or less wet. But you can get a good idea of the weight by weighing a number of receptacles, wheelbarrow or whatever it may be you use to carry the ash away full of dry ash. Then divide the total amount by the number of receptacles and you get the average weight. Of course you would subtract the weight of the holders from the total weight when making your test.

When one looks at such sheets every day, he soon notes any change in percentage of the ash to coal burned even without calculation; and so by comparing the coal, ash and water evaporated, can quickly note a change in quality of coal or firing.

the circulating water getting in with the feed. The finding of faults by means of meters and the daily registration of their readings, before the fault becomes large, is one of the reasons for doing work of this kind.

The regular keeping of temperatures is often of much help in finding the cause of trouble. They may be taken every hour or as often as thought necessary, but ought always to be taken at some fixed time. Of course the very best way is to have automatic recording thermometers, but this is a refinement which many do not care to pay for.

If the load is normal and the heater does not heat the water to the usual temperature, it is possible that the heater is dirty. The same may be said of the economizer. The scrapers might have stopped, or a portion of the apparatus become broken. A change of

the usual temperature would show the need for investigation. Many other things suggest themselves to you, but enough has been said to explain its use. There is no reason why the fireman cannot keep this log as a part of his regular routine. Under remarks may be noted anything out of the ordinary, poor coal, much dirt in the coal, leaks. The hour a fire was started in a certain boiler and so on. It is often of use to know who was on watch 6 months ago when such and such a thing happened. For this reason the names of the men on watch ought always to be on the blank.

Keeping Tab in Engine Room

It is necessary to know what the engines are doing, so then a blank such as Fig. 2 may help to keep track of their performances. If the plant is arranged so that each engine with its condenser and auxiliaries makes a complete unit and cannot be cross connected with the others, then the condenser heading may be cut out, for in such a case the engine generator and auxiliaries would come under 1, 2 or 3, as the case might be. The object is to find out the amount of work done by the various machines. If one does it more efficiently than the other, then the lack should be inquired into. This is specially true of the auxiliaries if they are in duplicate and you get better results from one set than you do with the other. On this blank can be arranged a space for the wattmeter readings, or, depending on the amount of data needed, on another blank such as Fig. 3.

This blank can be extended at will. If there are recording wattmeters for each line, they may each have a space. In this event it may not be necessary to put down the amperes and voltage except to keep a check on the wattmeters. The headings, power, light, station, may not have recording meters for each division, but will have ammeters. If there be a special man to take charge of the operation of the electrical apparatus, he should keep this log and his name be on the blank.

At the end of the month, the totals from the various data sheets should be tabulated and compared with the same month of the previous year. At the end of the year the grand total should be made up. This may be illustrated by Fig. 4, which is a copy of a monthly sheet used in a plant under the care of the writer. It is a very different plant and used for a different work, from the one we have under consideration, but the idea is the same. The electrical load is very even, so no mention of it is made on this sheet. The data for this sheet is taken from Fig. 5.

DATE

DAILY DATA OF STEAM & ELECTRIC PLANT

HR.	BOILERS		STEAM		ELECTRICAL VENTILATION								REFRIGERATION								ELEV. PUMP		COAL			ASH			REMARKS
					DYNAMOS					MOTORS						BRINE		TEMP.											
A.M.	1	2	BOILER PRESS.	BK. PRESS.	1	2	3	AMP.	VOLTS	F. ENG.	1	2	3	GEN.	AM. PUMP	BR. PUMP	IN	OUT	C.R.	OUT SIDE	CW. IN	CW. OUT	5	6	DAY	NIGHT	TOTAL	DAY	NIGHT	TOTAL	
7:00																														
7:30																														
8:00																														
8:30																														
9:00																							WATER							
9:30																							METER I		METER II		TOTAL USED			
10:00																														
10:30																														
11:00																														
11:30																							MAKE UP METER							
12:00																							ICE		METER III		TOTAL USED			
12:30																														
1:00																														
1:30																														
2:00																														
2:30																							GAS							
3:00																							METER I		METER II		TOTAL USED			
3:30																														
4:00																														
4:30																														
5:00																							PUMP COUNTERS							
5:30																							COUNTER 5		COUNTER 6		TOTAL			
6:00																														
6:30																														
7:00																														
P.M.																														

FIG. 5. BLANK FOR DAILY RECORDS

Record of Supplies and Repairs

Many of the stores are carelessly or even wilfully wasted. For this reason close watch must be kept on them. The easiest way is to have a card system, using 3x5 cards, such as Fig. 6. Some one person should be directly responsible for the storeroom. A set of cards may be kept for each watch if found necessary, using different colors to distinguish the one watch from the other. Such material as packing, especially in the small sizes, could be given out of the store in fixed amounts, say ¼ or ½ lb., and entered against the person or machine for which it was issued. This prevents such an entry as "one ring of packing 2-oz.," and keeps track all the same. This system acts as a continual stock taker. Of course it is necessary to verify the cards every so often by actually counting

or weighing the goods, and so detect any possible error. This is much easier than keeping a stock book and one can always insert a new article without disturbing any of the other items. An ordinary A to Z set of index cards will help to locate the various items, which may be arranged in alphabetical order, or under divisions.

Repairs

Bills for material, repairs, etc., can be easily taken care of by the use of ordinary 3x5 ruled cards. Write

ARTICLE- OIL-CYLINDER PRICE 40 ¢

07 - 08

DATE	QUANTITY REC'D	GIVEN OUT	ON HAND	DATE	FOR	COST	
MARCH 1			54				
" 4	100		154				
" 4		10	144		MAIN ENGINE	4	00

FIG. 6. METHOD OF LISTING SUPPLIES

headings on the cards, Engineers' Supplies, Oil, Waste, Repairs to Boilers, Brickwork, Engines, Piping, etc., Coal, and as many divisions as are necessary to meet your case. If you are asked to give a yearly report to be used as part of the general report, it is well to keep your divisions in accord with the divisions under which they are placed in the general report.

Fig. 7 will give an idea of how this may be carried out. The number over the amount is the number of the bill for the year, put in consecutive order. The No. 1826 is the order number. The number of the

REPAIRS ENGINES

07-08 148

MARCH 13	BALL AND WOOD NO. 1826	$ 68.49

FIG. 7. SAMPLE REPAIR CARD

bill is also on the check sent in payment and placed on this bill when O. K'd. If you write your own orders, or have a copy of them on file, if you desire details of the account, turn to the order by number, and you have it right away. The numbered bill (order number also on the bill) will also be easy to find, and then you have the whole affair before you.

A monthly statement of cost can be made up from your various sheets something after the fashion of the right side of Fig. 4. In this case we have to pay for the removal of our ashes at a fixed rate per can. In the suburban plant, if it takes the time of one man to wheel away the ash, his time should be counted as ash expense, unless it be preferred to put it in as wages. The item general supplies does not include tools or repairs. They come in on another account. The item refers to regular supplies outside of those specially mentioned.

Figure 8 shows the ash ticket signed by the driver when carting away ashes. A carbon copy is made at the same time and kept as a check. Bills are made out from these tickets. They prevent disputes.

Where your output is practically all electricity, a record of coal per k. w.-hr. should be kept. The total monthly cost divided by the total k. w.-hr. will give the cost per k. w.-hr.

The cost of water may also be put in the account as a separate item. If taken from a river, the esti-

ASH TICKET

DATE ..... 190...

CANS OF ASHES .....

" " SOOT .....

" " REFUSE .....

TOTAL: .....

DRIVER .....

FIG. 8. ASH TICKET

mated cost of pumping may be taken (from counter on pump) or the cost simply charged up to auxiliary machinery.

All of the foregoing is more or less general, although the writer has kept the suburban power station in mind while writing. To get up a thorough working system for a special plant, one should study it on the spot. As far as possible, it is well to have all blanks of uniform size for convenience in filing.

When ordering parts for the machinery, one ought always to be careful to give the shop number, style, size, etc., as found on the name plate. In this book a record should be made of every piece of machinery.

Work out the constants for each engine, that is to say, find the power of the engine with a m. e. p. of 1 lb. Then when you take your indicator cards and obtain the true m. e. p. all you have to do is to multiply it by the constant, and there you are. This avoids going over the same work many times. The size of all piston rods, with the depth of their stuffing boxes should also be made, as well as the size and kind of packing for each rod and the weight to pack the box. This work may be done at odd times. It is worth the work for the time it saves. A saving of one per cent of the gross charges for operating such a plant as we have had in mind, is such a sum as justifies a good deal of work in getting up a system or whatever is necessary to attain this result.

INDEPENDENT DRIVEN CONDENSING APPARATUS

This self contained apparatus consists of a single acting air pump driven by a Corliss engine directly connected by crank and shaft. On the shaft is mounted a heavy inertia balance wheel to assist in the speed regulation. The action of this condenser is on the jet venturi principle. Exhaust steam entering the condenser in a state depending upon its density, volume and temperature, is met by a spray of cold water, causing a change in the volumetric density of about 1/1700th part of the original volume occupied. The resulting volume of water, vapor and air is removed by the action of a plunger of properly proportioned displacement.

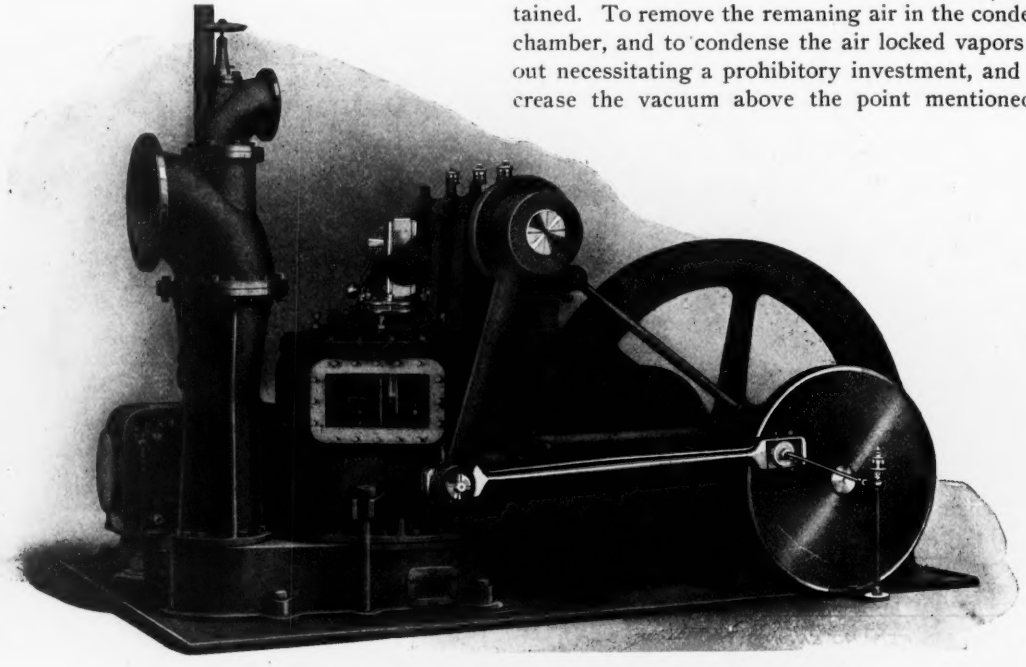


FIG. 1. SINGLE STAGE VENTURI JET CONDENSER DRIVEN BY CORLISS ENGINE

Injection water may be thrown in any sized spray inside the condenser cone, and in the event of foreign substances passing the foot valve screen, the spray orifice may be cleaned by the manipulation of a hand wheel shown at the top of the inlet elbow in Fig. 1.

The air pump operates upon the single acting principle, and is fitted with hard rubber valves, held by bronze studs and check nuts. Valve openings aggregating ample area, prohibit the possibility of retarding the water of condensation. Two large manholes are provided at the level of the outlet valve, which permit easy access to the interior parts of the pump, should occasion require it.

As can be seen in the illustration, the plunger is operated by a vertical swinging arm connected to the crank on the condenser side of the main engine. By this construction, the air pump plunger, when in motion, starts from the end of its stroke very slowly and increases to its full speed at 50 per cent of its stroke; then decreases in its speed to the corresponding slow point of commencement at the end of its stroke. It has been found that this combination of principles produces a quiet and easy operating air pump.

An air pump, when operating under general conditions, does not remove all the air which enters a condenser with the injection water, and at sea level a vacuum of about 26.5 in. is all that is ordinarily obtained. To remove the remaning air in the condensing chamber, and to condense the air locked vapors without necessitating a prohibitory investment, and to increase the vacuum above the point mentioned, has been and is the aim of the condenser designers.

In the Venturi two-stage condenser shown in Fig. 2, a high vacuum is obtained with but slight additional expense in construction.

The principle of the two-stage apparatus is to provide a special and separate means for the removal of water and air, and to this end the ordinary pump is given the water to remove and another pump of different design and action removes air and warm vapor directly from the uppermost part of the condensing chamber.

At the top of the condenser a chamber is placed to receive the warm vapor and rarified air from which it is drawn by the action of the vacuum pump to and through a small auxiliary condenser, seen in the illustration, from where it is discharged into the overflow of the main pump.

The general design of the two-stage condenser is similar to that of the single stage previously described.

The additional pump, which is intended to remove the noncondensible vapor, is of less diameter and longer stroke than the other, and obtains motion from the same shaft. The increased stroke of this vacuum pump is obtained by the length the rocker arm integral to that of the water pump, so that an alternate motion is given to each, and it also gives a balance effect in regard to the respective weights of the plungers and their distance from the center of the rod shaft, all of which tends to make the whole mechanism easy running. The driving engine, condenser and pump are

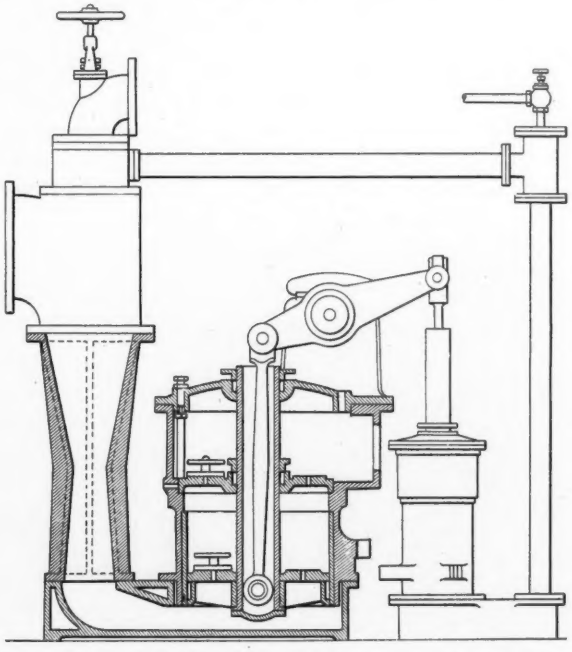


FIG. 2. TWO-STAGE APPARATUS WITH WET PUMP AND CONDENSER IN CROSS-SECTION

mounted on a heavy cast-iron bedplate covering the entire foundation, thereby increasing the rigidity of the entire mechanism and making the whole self-contained.

Venturi condensing apparatus is manufactured by Hewes & Phillips Iron Works, Newark, N. J.

CAN STEAM BE USED AS A FIRE EXTINGUISHER?

By A. G. Williams

Some years ago I read an essay on steam as a fire extinguisher, which I think will interest every practical engineer, because it is intimately connected with his profession, and if it comes into more general use, will become an important part of his business.

The essay above mentioned appeared in Chambers' Journal, an English weekly magazine. It quotes a remarkable experiment, which proves that steam as a fire preventative and extinguisher is not only a sure remedy for fires, but has the advantage of smothering a fire in its start.

An old woolen mill near Bradford, England, was condemned as unfit for further use, and was to be demolished to make room for a modern factory. It had existed for about a century, the whole structure had become saturated with woolen grease, and was anything but fireproof.

An old fashioned steam plant was used for running the machinery. All the machinery was removed, the steam pipes were left, a thermometer was placed in the main room, a wire connected to the lower bulb so as to make contact with the mercury, another wire inserted in the upper column so that as the mercury column rose it would close the electrical circuit with an ordinary chemical battery. The two wires were attached to an electro-magnetic coil and the armature on the completion of the electrical circuit through the mercury would open the steam valves and allow a full head of steam to flow.

A huge heap of shavings and other combustibles saturated with tar was piled up on the grease-sodden floor and set on fire, the doors and windows closed. Two hours the spectators waited outside to see the old mill burst into flames. The mill did not burn. Everything remained as usual. On their opening the door they found the heap of fuel merely charred. The electrical steam valve device had acted at once as the temperature became higher, the steam poured into the room and put out the fire. The greasy floors and walls were undamaged.

Is this not a convincing proof that a steam fire preventive system is not only a sure safeguard against fires, but also a safeguard against the great, if not greater, damage by water?

Steam can be used in the tallest building where water from fire engines connot be used. A few pounds pressure of steam would reach the top of the 41-story Singer Building in New York, with no other piping than that used for heating purposes. No heavy, cumbrous water tank would be needed, and instead of water sprinklers and rolls of hose, the steam pipes would need only a thermostatic device in every room fitted with proper safeguards against interference.

A steamheating system can be converted into a steam preventive fire system at a very slight expense, which would be more than covered by the savings in 1 year's insurance, or, at any rate, the lower insurance rates which would inevitably be charged when an efficient automatic fire service is installed. One drop of water converted into steam is expanded 1,700 times the original volume. Therefore, one drop of water converted into a non-inflammable gas is 1,700 times more efficient than the liquid. It can penetrate the cellar or the highest story, and on its liquidation it returns to 1/1,700 of its fire-fighting energy, so that the resultant damage to the surrounding structure would be reduced to 1/1,700 in water flooding.

All the above advantages would be true if steam can effectually be used as a fire extinguisher.

GAS ENGINES AND PRODUCERS

ECONOMIC PERFORMANCE OF ENGINES AND PRODUCERS*

By Louis Bendit

HOW rapidly the change from invention to design in the gas engine field is coming about must be apparent to you for the papers are continually publishing articles covering the many points involved and giving description and reports of tests of various well-designed plants whose high economic performance causes you to wonder if the results are accurate. I come to talk over this matter supposing that you are thoroughly familiar with the history of the "Beau de Rochas," commonly called the Otto or 4-stroke cycle and the Dugald Clerk or the 2-stroke cycle, so shall proceed at once to the matter in hand and consider a modern gas power equipment.

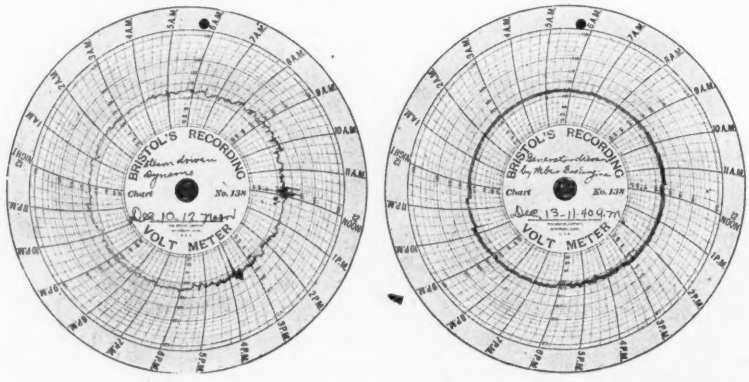


FIG. 1. VOLTMETER CHARTS FROM GAS-ENGINE DRIVEN GENERATORS

Sources of Fuel

The present sources of fuel for large gas engine work are as follows:

Kansas natural gas which has a heat value of 925 B. t. u. per cu. ft. at 60 deg. F, 29.2 in barometer. This contains Marsh gas 96 per cent, nitrogen 2 per cent, hydrogen small amount, and requires 9 times its volume of air for a proper mixture.

Producer gas from Anthracite coal, with heat value of 135 B. t. u. per cu. ft.

Producer gas from coke, with heat value of 125 B. t. u. per cu. ft.

Producer gas from charcoal, with heat value of 125 B. t. u. per cu. ft.

Blast furnace or coke-oven gas, with heat value of 90 B. t. u. per cu. ft.

You will observe that I have not included producer gas from bituminous coal as it is only in plants of large size that this fuel can be utilized and a little later we will enlarge upon this point.

The natural gas being low in nitrogen and hydrogen permits high compression; its calorific value is fairly uniform, therefore, to get the best results with it a gas engine should be designed for a compression of from 90 to 100 lb. That is when the engine takes a charge of fuel, 1 part natural gas and 9 parts air, it is compressed to a point just below where preignition would occur. Then at the proper instant it is set afire by an arc flame (not spark) inside the engine cylinder.

Governing

You all are familiar with the two methods of governing the gas engine, one the "hit and miss" method or rather lack of method which takes a charge of fuel, 1 stroke and may not take it the next fourth, eighth, twelfth or sixteenth stroke or more thereafter; the other is the "throttling governing," that is a charge of fuel is taken in every fourth stroke proportional to the work required and its analogy is to be found in the throttling governing steam engine. This type of gas engine alone has been found satisfactory where the service demanded accurate and uniform regulation such as driving flour mills, cotton mills and direct or alternating-current generators. It has proved equal to the demands even to driving alternators in parallel. Of course, by the use of immense flywheels on the hit and miss governed gas engines and adding balance wheels on the armature shaft of the dynamo, they have given fair performance.

For instance in a recent contract for a 140-h. p. natural gas engine for driving an alternator, one of the

*Presented before Kansas City, Mo., No. 5, N. A. S. E.

bidders offered an engine which weighed about 25,000 lb. to which was hung a flywheel weighing nearly 50-000 lb. to resist the impulses given out hit and miss. Of course, it was a single cylinder engine, whereas the successful bidder, the Weber Gas Engine Co. of Kansas City, Mo., offered a multicylinder engine with throttling type governor weighing 22,500 lb. with two flywheels weighing 9,000 lb. additional or a total of 31,500 lb., less than half the weight of the other engine.

What about results. Here they are plainly delineated through the help of Bristol recording voltmeter charts, Fig. 1. The left-hand is the record taken Dec. 10, from the alternator driven by a modern 4-valve steam engine which you will grant keeps the voltage fairly uniform. At the right is the record for Dec. 13, from an alternator driven by a Weber multicylinder natural gas engine, which gives an even more uniform voltage, notwithstanding that the electric load is part lighting and part motor service. In Ottawa, Kans., the city employed a consulting engineer whose horizon could not comprehend any prime mover not actuated by steam. After an unsatisfactory trial of a steam plant both coal and gas fired, they concluded to install a gas engine inasmuch as the builders guaranteed a brake horsepower-hour on a consumption of 12,500 B. t. u. or about 13 cu. ft. of gas. The results of an official test proved that the guarantee is fulfilled and the gas engine is at work 24 hours every day except Sunday, saving for the owners $375 every month over what it cost to operate the steam power.

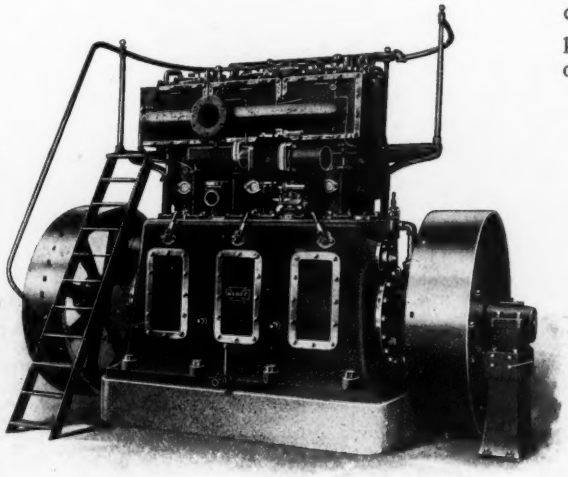


FIG. 2. A VERTICAL THREE-CYLINDER ENGINE

This engine is so designed that if at any time the supply of natural gas should become exhausted, suction gas producers are to be supplied and the necessary changes in the compression made and they will then continue in the same economical manner.

Producer Action

So much is being talked of at the moment about the suction gas producer, that it might easily be imagined that this acted upon lines altogether different from other producers, whereas its action in no wise differs from that of all other gas producers. A sectional view of such a producer built by the Weber Gas Engine Co., is shown by Fig. 3.

In the pressure producer, the air is driven through by means of a blower fan or exhauster, in the suction producer, the engine to be driven draws in its own gas from the pipes which connect it to the producer, and the gaseous contents of the producer are driven forward into these pipes by the atmosphere, which is now enabled to flow into the partially exhausted producer.

The action is as follows: Air entering the producer combines with the first of the fuel it meets and forms carbon dioxide, evolving great heat, and raising the fuel for some distance to a high temperature. As the gas travels upwards through the heated fuel it next combines with a second molecule of carbon, producing carbon monoxide, and where the first oxidation of a pound of carbon to its full oxide produced 14,647 units of heat the absorption of another atom of carbon demands 10,232 heat units to gasify the carbon, and only produces actual heat to the extent of 4,415, so that from the 2 pounds of carbon which go to produce 4 2/3 pounds of carbon monoxide only 8,830 heat units are produced in the producer when working perfectly, or without production of the dioxide. The heat thus actually produced may be made to evaporate water, and the air when it goes to the producer carries with it the vapor thus produced, and a small quantity of water gas is thus generated, so that the final gas produced contains rather less nitrogen, and it contains a moderate percentage of hydrogen, which in the case of small engines, is useful as a quickener of combustion. The finally escaping heat helps to make hot the cold fuel, and it may even be used to heat the incoming air. So little heat is ultimately rejected that suction producers are claimed to have a thermal efficiency at times as high as 80 per cent.

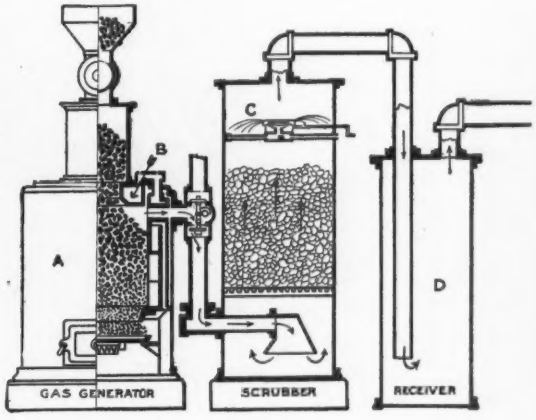


FIG. 3. SECTION OF SUCTION PRODUCER PLANT

Of course, the suction producer has a freedom from leakage, which is a desirable quality in a confined space. At the same time, any room containing a suction producer should have good ventilation, preferably by some flue, into which, at some little distance, the gas engine exhaust pipe should discharge upwards, as this keeps it warm, so as to ensure an up-draft that will clear the room of any chance gas; to ensure the proper up-cast in this flue, a free opening to the room from some other source must be provided to let in air for the producer, otherwise the air will be drawn down the up-take flue.

All suction producers are practically alike. It is essential to their best success that their fuel should be dry, of even size, and of a nature to fall freely, so as not to form cavities. There is much greater risk of air passing by short circuit through the fuel than when the air is blown in under a pressure, and there is a plenum in the producer. The small size of a producer is not, of course, favorable to the free falling of the fuel, for this can arch itself across the chamber and the over-burden also being small, such arching is less readily crushed in. Within reason, therefore, a producer should be tall, so as to produce downward loading on the fuel, and it should be as narrow as consistent with good working.

The fact that the fuel shrinks as it descends owing to its gradual oxidation is equivalent to rendering a parallel producer tapered wider below, for a mass of shrinking fuel cannot so readily wedge itself fast as it descends.

Pressure producers using bituminous fuel must be designed either as double gas generators or for re-entry in the single gas generator type so that the condensable volatile gases released from the green fuel at the lower temperature are passed through the incandescent zone of the fuel bed in order to split up the hydrocarbon gases and fix them. Where this is not done some mechanical means such as centrifugal washers and cleaners must be provided to remove the tar and other undesirable materials from the gas. This is rather a waste of fuel, and by-product recovery auxiliaries are provided in the larger plants to recover ammonia, etc.

A water heater for utilization of the waste heat in the exhaust of a gas engine, has been applied to a 50-H. P. gas engine, 2 cylinder, vertical type with 2.5-inch exhaust connection from either cylinder in each of which was inserted a short length of pipe containing a series of cast-iron heater sections, fitting within the pipe and containing 35 cu. ft. of surface each. The water in these heats rapidly and circulates naturally through an 80-gallon tank which is boiled every 2 hours.

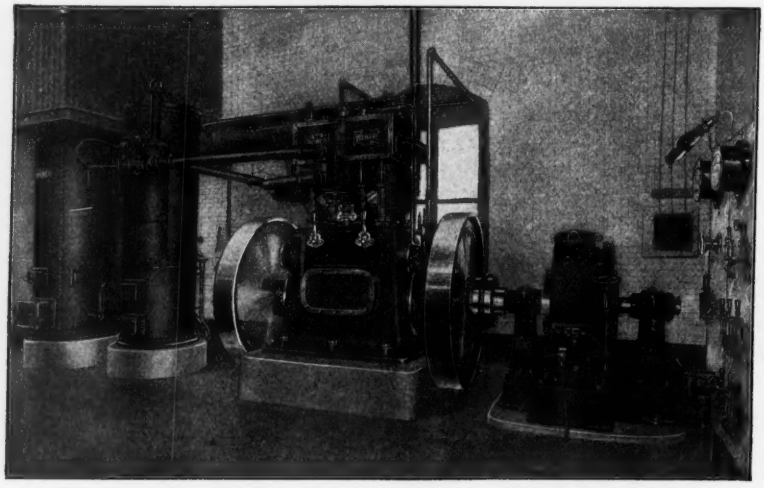


FIG. 4. A SMALL SUCTION PRODUCER PLANT

Cost of Operation

Comparing costs of steam and gas engine plants, for a small station in the Central states where conditions were alike, the repairs for the year on the gas engine installation cost 0.219 cents per k. w. hr. and those on the steam installation 0.4451 cents. Cost of fuel for the gas plant was 0.679 that for the steam plant per k. w. hr.

In small sizes, such as shown in Fig. 4, the first cost of a gas power plant has been found to be 25 to 30 percent greater than for a steam plant, but the economy of the former has been clearly demonstrated by many plants both in Europe and this country.

For a 100-H. P. plant at Moose Jaw, Assiniboia, J. E. Ashworth gave as cost, not including fixed charges; fuel, 125 lb. an hour (anthracite $7 a ton), 44 cents an hour; labor (1 man at $3 a day), 30 cents; oil and waste, 5 cents; total operating cost 79 cents an hour for 100 H. P. at the flywheel.

At Cambridge, Neb., P. B. Cole, manager of the Electric Light and Power Co., states that he has a 65-h. p. Weber gas plant direct driving on a 45-kw. direct-current generator supplying 750 lamps and operating from dusk until 11 p. m., and in winter from

assistant do all the work for the plant and system inside and out. During 1907 the plant ran 2550 hr. and generated 85,950 k. w. hr.; it burned 153,000 lb. of coal or 1.8 lb. per k. w. hr. at a fuel cost of 0.75 cents; the labor cost was 1.75 cents, oil waste and supplies 0.08 cents; interest at 6 per cent, depreciation at 7 per cent and taxes at 2 percent cost 1.07 cents; or a total cost per k. w. hr. of 3.7 cents.

PRODUCER GAS AND GAS PRODUCERS

By R. T. Strohm

THE larger part of the power output of the world is derived, primarily, from coal in one or another of its various forms. Furthermore, the available coal supply, according to present knowledge, has been estimated as sufficient to furnish the world's power for a period of from 100 to 200 yr., at the end of which time that form of fuel will be practically exhausted, unless new deposits shall in the meantime be discovered. The economical utilization of this fuel, therefore, becomes a problem of daily increasing importance, not only on account of the limited supply, but far more on account of the close competition existing among producers of power in the matter of generating it cheaply.

As a result of this rivalry it is not surprising that, in recent years, considerable attention should have been paid to the possibilities of producer gas, in conjunction with gas engines especially adapted to its use, for the cheap and economical production of power. At the present time, producer gas is no longer a mere idea or conception, but a recognized factor in power-plant engineering. The reasons for this sudden springing into notice and favor are not difficult to discover.

Comparative Efficiencies of Steam and Gas Engines

As compared with the generation of power by combustion in a boiler furnace and subsequent transformation by a steam engine, the producer and the gas engine are by far more economical. With triple expansion condensing engines, about the best results yet obtained have been 1 brake horsepower per hour at a fuel consumption of 1.5 lb. This was accomplished by the most efficient form of steam engine, under the most favorable conditions, and is, therefore, far above the average working conditions. A coal consumption of from 2.5 to 6 lb. per horsepower per hr. in plants working under ordinary conditions is the usual performance.

The economy obtained by the use of producer gas in gas engines is far superior to that of the steam plant. In a series of tests upon producer plants, in which the brake horsepower of the engines ranged from 8 to 20, the coal used per brake horsepower per hour varied between 1.2 and 0.8 lb., the lower figure corresponding to the engines of greatest power. For, as in steam-engine practice, the larger units operated by producer gas show a better economy than the small ones.

From the figures thus given, it will be apparent that under very ordinary conditions, with engines of low power, the producer plant can do as much as the the best type of steam plant, and do it at just half the fuel cost. Cutting the coal bill in two without any falling off in output is a thing of sufficient importance to cause any plant manager to sit up and take notice.

Process of Combustion

Producer gas is simply a lean gas, that is, a gas of comparatively low heating value. In composition it is a sort of mixture of air gas and water gas. The method of its production may be clearly and simply explained by alluding to the process of combustion in the furnace of a steam boiler. In the case of the boiler, the coal upon the grates is largely burned to form carbon dioxide, and the aim of the fireman is so to regulate the air supply and the conditions governing combustion as to convert the greatest possible percentage of the carbon into the dioxide form. In other words, perfect combustion is the desired end to be attained. The fireman knows that too great a supply of air will result in incomplete combustion, and a consequent falling off in the economy of the boiler plant, and for that reason he tries to prevent the formation of carbon monoxide, due to partial and incomplete combustion.

In the formation of producer gas, the aim is directly opposed to that in the steam plant. The gas is generated in a cylindrical furnace containing burning fuel, but it is the main object to have incomplete combustion rather than to prevent it, and it is desired to convert as much of the coal as possible into carbon monoxide, at the same time keeping the percentage of dioxide low.

Obviously, therefore, the management of the steam boiler and the gas producer must be diametrically opposed, in spite of the fact that both are simply processes of combustion. In steam boiler practise, to insure a sufficient supply of oxygen to enable all the hydrocarbons to be completely consumed, it is customary to admit an excess of atmospheric air to the furnace, this excess being commonly as great as 100 per cent. In the operation of a gas producer the air supply is reduced far below the amount theoretically required to cause complete combustion of the fuel, and the result is the formation of a considerable amount of carbon monoxide.

Generator or Producer Proper

Producer gas is made in a vertical cylindrical chamber that, in external appearance at least, is not

greatly unlike a vertical boiler. This part of the apparatus is called the producer or generator. There are two main classes of producers, known as suction producers and pressure producers. The difference between the two is the manner in which the draft is maintained, by which combustion is supported. In a suction producer, the gases generated are drawn out of the generator by the suction of the gas engine attached to the producer plant. In a pressure producer, the air is forced into the generator under pressure, as by the use of a small fan or blower. Thus, in a suction producer the pressure is less than that of the outside atmosphere, while in a pressure producer the pressure inside is greater than that outside.

A sectional view of a small suction gas producer with auxiliary apparatus is shown in the accompanying illustration. That part of the system to which the fuel is fed and in which the gas is generated is known as the generator and is indicated by A. It consists of a cylindrical shell built up of steel or wrought-iron plates riveted together, and forms several sections. The lowest of these, shown at B, is the ashpit, in which a door, C, is provided for the removal of ash and clinker. The next section above forms the combustion chamber and contains the fuel D, from which the gas is made. This portion of the generator is heavily lined with fire brick E, to protect the outer shell from the direct heat of the fire, while between the shell and the fire brick a layer of mineral wool or sand, F, is inserted, as an additional safeguard against damage to the shell on account of the high temperatures within.

Above the combustion chamber is the section G, containing water and known as the evaporator. The evaporator communicates with the closed ashpit, B, by means of the pipe H, and with the outside air by means of the opening at I. The central portion of the evaporator forms a magazine that holds a supply of fuel, this fuel being fed into the generator from a hopper, J, at the extreme top. A small hand blower is installed at K and connected to the pipe H leading to the ashpit. It is used only in starting up the producer after a period of inoperation.

Washing and Purifying the Gas

The upper end of the combustion chamber D opens into the vertical pipe L. This pipe leads to the open air through a valve, M, at its upper end, and the lower end connects with the bottom of the cylindrical chamber N, known as the scrubber. It is a steel shell having a grating near the bottom, just above the pipe inlet, and on this grating coke is placed until the shell is filled up to a point near the opening leading to the pipe O. Water conducted into the scrubber by a suitable pipe is sprayed by the spraying head P and trickles down through the coke, collecting in the bottom of the scrubber and then flowing over into the trap Q, whence it is drawn off to the sewer.

The pipe O leads from the top of the scrubber to the interior of another cylindrical receptacle, R, known as a purifier. The purifier contains a number of trays, S, S, carrying layers of sawdust, and the interior of the chamber below the lower tray opens into the pipe T, which is the gas supply pipe to the engine. A shield or cover, U, prevents dirt from being carried into the pipe T and thus into the gas engine cylinder. At V in the pipe leading from the generator to the scrubber, a valve is placed, to serve as a test valve.

Operation of Producer

To indicate the method of operation of the producer, it is perhaps best to describe the successive steps in sarting and maintaining the action. Assuming that the generator, scrubber, purifier and all intermediate piping are in place and the engine connected to the pipe T. The first thing to do is to open the valve M in the pipe L, so that when a fire is started in the generator, any gases resulting will pass out to the atmosphere. The next thing to do is to fill the evaporator G with water and then to start the water flowing through the scrubber by opening the valve in the sprinkler pipe.

Starting the Fire.

Next, a supply of dry wood containing little or no pitch is placed on the grate in the bottom of the generator, and fire is set to it by throwing in a bundle of lighted waste or small kindlings. The ashpit door, C, is closed, as is also the lid of the hopper, J. The air necessary to maintain combustion is then supplied by the blower K, which is turned by hand until the wood is thoroughly ignited. When this has been accomplished, coal may be fed into the generator through the hopper at the top, in small quantities, so as not to put out the fire already started. The blower is kept going until there is a bed of glowing coals in the generator from a foot to a foot and a half in depth. When the fire has reached this condition, there is no danger of putting it out easily, and the generator may be filled up to the normal working level with coal, as indicated in the illustration.

The blower should now be kept going, resulting in the formation of gas in the generator, and the gases thus formed are driven out into the pipe L, from which they escape to the atmosphere through the open valve M, although a small amount may pass downward into the scrubber. When the blower has been in service a short time, the valve V should be opened, and as the gas in the pipe L is under a slight pressure, gas will escape from the open valve. This gas should be lighted, so that it burns at the end of the valve in a small jet. At first, the color of the flame will have a yellow or luminous cast or tinge, but this will gradually change until at length the issuing gas will burn steadily with a bright blue flame that sheds very little light. When this blue flame appears, it is a sign that the generator is working properly and generating the correct quality of gas.

Cleaning the Grate

If it is desired to clean the ashpit or grates at this

time, the blower should be stopped, and all ash and clinker quickly removed from the base of the generator. The necessity of haste is explainable on the grounds that keeping the doors open an unnecessary length of time will admit excess of air and spoil the quality of the gas already made. Even as it is, the dilution of the gas inside will need to be remedied. As soon as all ash has been removed, the ashpit doors should be tightly closed and the blower again operated until the gas at the test valve V shows the desired blue flame.

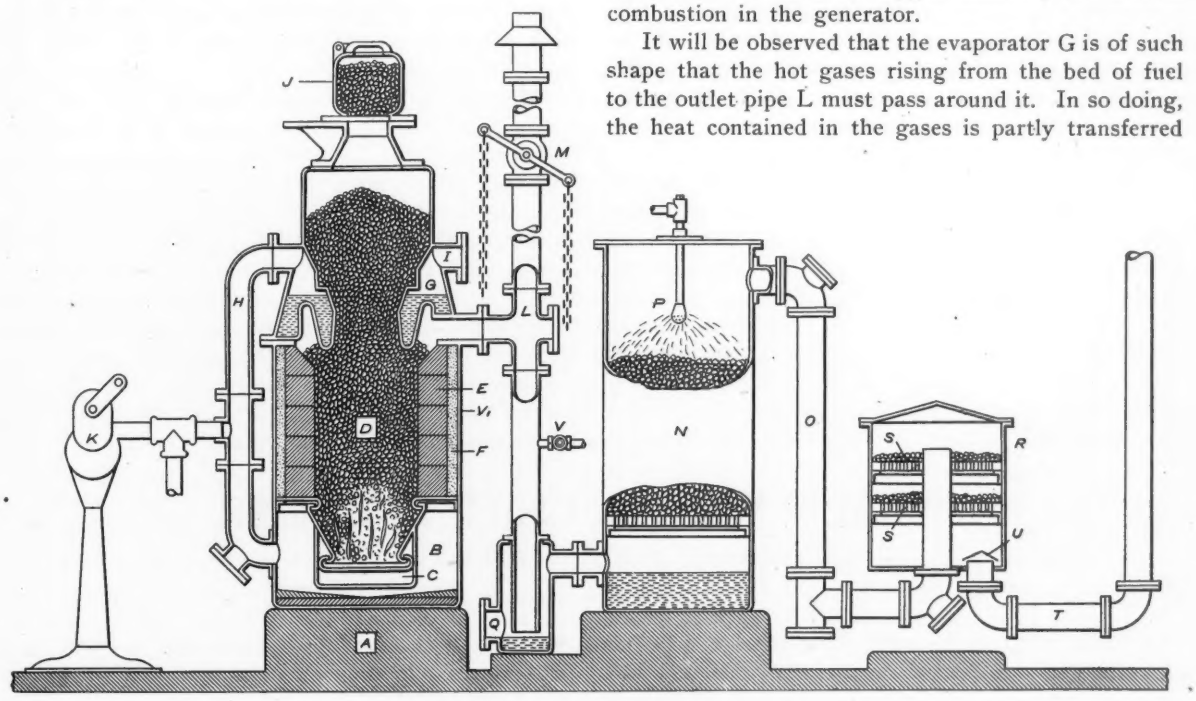
Generating Gas

The next step is to fill the scrubber, purifier and all pipes, as far as the engine, with the gas. To do this, the valve M is closed, and the gas is then forced to pass down into the scrubber, up and out at the pipe O, and thence through the purifier into the pipe T leading to the engine. At some point in this pipe T, near the engine, a vent is provided, which can be opened or closed by a valve. At first, this vent is left open, so that the gas generated flows through the various pipes and parts of the apparatus and escapes when it reaches the vent. The quality of the gas escaping at this point should be tested, also, by igniting it at another test valve located at this point, but not shown in the illustration. When the characteristic blue flame appears, it may be concluded that the whole apparatus is now filled with gas of the desired quality. The vent pipe and all other openings between the generator and the engine should now be closed, and the blower shut down.

Suction Action

Of course, discontinuance of the blower action removes all draft from the fire, and to maintain proper operation of the producer, the draft must be re-established. This is done by starting the gas engine attached to the pipe T. The engine, on each suction stroke, will draw a charge of gas from the pipe T, and the rapid recurrence of these suction strokes will tend to produce a partial vacuum in the system. The only opening from the atmosphere to the interior of the producer is by way of the pipe I and thence down through the pipe H to the ashpit. Consequently, a steady current of air will be drawn in at I, and, after passing over the surface of the water in the evaporator G, will be led to the under side of the grate, where it will furnish the oxygen necessary to maintain combustion in the generator.

It will be observed that the evaporator G is of such shape that the hot gases rising from the bed of fuel to the outlet pipe L must pass around it. In so doing, the heat contained in the gases is partly transferred to the water in the evaporator, the water being heated to within 30 or 40 deg. of the boiling point. At such a temperature, and under the influence of the current of air entering at I and moving across its surface to H, the water vaporizes readily, and the water vapor is carried along with the air to the bottom of the generator, beneath the grate.



ARRANGEMENT OF SUCTION GAS PRODUCER

Automatic Control of Gas

The temperature of the water in the generator is not constant, unless the load on the engine and the other operating conditions are fairly unform. The temperature of the water depends on the temperature of the gases rising from the producer, and these are hottest when the draft is most intense. The draft, of course, is due to the suction of the engine, and

consequently, when the load on the engine is greatest, and when it is using the maximum amount of gas, the fire in the generator is most intense. Such a state of affairs will at once commend itself, since it means that the adjustment of the rate of gas generation is automatically governed by the demands of the engine, and furthermore, any change in the demand is immediately felt at the generator end of the system.

The temperature of the fire does not necessarily increase in proportion to the increase of load. The effect of the water vapor must be taken into consideration. As the temperature of the fire increases, the water in the evaporator grows hotter and a larger amount of it is evaporated and conveyed to the ashpit. As it rises through the incandescent bed of fuel, it absorbs heat, and thus has a cooling effect on the fire. Moreover, the stronger the draft produced, the greater the amount of moisture carried into the furnace, and the greater the cooling effect. Thus the increase in the amount of vapor acts so as to cause a more uniform condition of the fire.

The presence of water vapor in the air supply has another great advantage in that it helps to prevent the formation of slag that would otherwise run down on the grates, or adhere to the walls of the combustion chamber, producing clinker. Any engineer who has had to deal with the problem of burning low-grade fuels that contain a large percentage of fusible impurities, knows that the introduction of a steam blast into the ashpit will prevent the forming of clinker, and will give a fluffy, powdery slag that can be easily shaken through the grates. Precisely the same office is performed by the water vapor that is entrained with the supply of air to the producer.

Naturally, the gas that leaves the top of the generator is very hot, on account of its recent contact with the burning fuel, and it also carries with it some dust and grit. To use the hot gas in the cylinder of the gas engine would be uneconomical, and to use it without removing the dust and grit would be to invite trouble in the way of cut and scored piston and cylinder surfaces, and valve seats, followed by leakage and loss in economy. As a result, it is not only advisable, but necessary, to cool and clean the gas before permitting it to enter the engine.

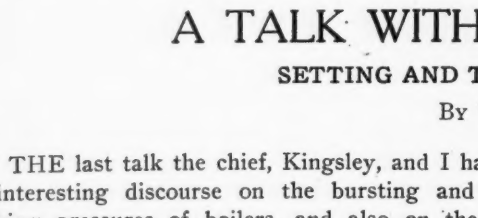
At the bottom of the pipe L the gas changes its direction of flow and in so doing the heavier particles of dirt are thrown down into the water in the box Q, from which they are flushed away to the sewer by the overflow from the scrubber N. The gas, still carrying the lighter, finer particles of dust, and still hot, passes into the scrubber, where it is forced to rise through the bed of coke, meeting with and mingling with the water injected by the spray head P. This quickly cools the gas, and likewise cleanses it, so that by the time it reaches the pipe O it is freed of most of its impurities and has a normal temperature. To insure the removal of any dirt that may have been carried along from the scrubber, the gas is made to pass downward through the layers of sawdust on the trays S. S in the purifier R, and here the last vestige of foreign matter is taken out, after which the gas is ready for use in the engine cylinder.

A TALK WITH A CHIEF ENGINEER

SETTING AND TESTING SAFETY VALVES

By Wm. Kavanagh

IN THE last talk the chief, Kingsley, and I had an interesting discourse on the bursting and safe working pressures of boilers, and also on the setting of tubular boilers. It is also necessary to know how to set safety valves, so I will tell you what the chief had to say on this subject.



SKETCH ILLUSTRATING LEVER SAFETY VALVE

There are three ways to set the safety valve. One is by calculation, another is by hydrostatic pressure, and the valve can also be set by steam pressure. The simplest and most reliable way to set the safety valve is by hydrostatic pressure. Setting of the safety valve by calculation is only problematic at best, but you may be asked to demonstrate this method, so I will explain it to you.

"There are three kinds of safety valves, known as the common lever, the dead weight, and the spring loaded valve. The common lever valve being commonly employed, I will consider this type.

Here the chief drew a sketch, similar to the one shown, and continued: "Let A B represent a safety valve lever 40 in. long and weighing 10 lb. Let the distance C D equal 5 in., the point G be the center of gravity of the lever, and let the distance from C to G be 20 in. Now let the safety valve be 4 in. in diameter, the weight W equal to 80 lb. and the valve V and stem weight 5 lb.

"To find where the weight must be placed to hold down, say 50 lb., we multiply the valve area by the pressure and then by the distance C D; from this product subtract the weight of the valve and stem, multiplied by the distance C D. The lever weighs 10 lb. and it acts with a leverage of 20 in. Now the product of the weight of the lever by the distance C G

must also be subtracted from the product of the valve area multiplied by the pressure and the distance C D. Divide the remainder by the weight W and the quotient will equal 36.7 in., which is the distance the weight must be placed from the fulcrum C.

"It is very easy to remember this rule by writing it arithmetically and studying the shape and quantities employed. Thus, we have:

$$\frac{(12.56\times50\times5) - (5\times5) - (10\times20)}{80} = 36.4 \text{ in.}$$

"If it is required to find the weight, the distance being given, it will be only necessary to divide by the given distance; the result, of course, will equal the weight."

Here the chief illustrated this problem by writing down the same figures with the exception of the divisor, and obtained for an answer 80 lb. weight, thus:

$$\frac{(12.56\times50\times5) - (5\times5) - (10\times20)}{36.4} = 80 \text{ lb.}$$

The chief then continued: "You see, Kingsley, all the quantities remain the same with the exception of the divisor. After the safety valve is set, you should prove the accuracy of the setting by allowing the presrue to rise to the point where the valve will rise or blow. The lifting of the valve when compared with your steam gage pressure, will determine how close your figures approached accuracy. You will note it is important to know the valve will lift at the proper time. To set the spring loaded or pop valve, it will be necessary for you to know how many pounds pressure will lift the valve when the spring compression nut is given one turn. The manufacturers of this type of safety valve usually supply this information by attaching a tag to the valve. If the tag is lost then you will need to find this pressure by trial.

"Suppose we are to carry 200 lb. pressure; we may proceed by screwing up the compression nut, say 3 times, and note what pressure will lift the valve. If the valve opens at 132 lb., then 132÷3=44 lb. per turn. Hence, to set the valve for 200 lb. pressure, a little over 4½ turns of the nut will be required.

"You may also be asked the question, how will you determine if your safety valve is large enough to prevent an excess pressure on the boiler?" Kingsley, in answer to this question, said: "The safety valve should have ½ sq. in. of area for each square foot of grate surface."

"Well," said the chief, "even if your safety valve had the area you speak of you are not sure the valve is sufficiently large.

"To discover this, raise steam to the blowing point, and then if you are not able to increase the pressure after your valve lifts, the valve is large enough. When you test your valve in this way, it will not be necessary for you to carry your regular working pressure, but of course the closer you approach working conditions the more satisfactory will be the result."

FLYWHEEL EXPLOSIONS

By F. S. Palmer.

FROM long experience I feel certain that more such explosions will occur in 1908 than last year; first, because falling off in business always causes retrenchment and many engineers will have to attend to both firing and running the engine. Second, because cheap oil used in many engine rooms will cause sticking governors. Third, because old engines will be kept running when new ones should be installed, in order to let corporations pay dividends. Fourth, because first-class engineers will be discharged and cheaper men hired.

Steam pressure will be as high if not higher this year than last, which with the above mentioned causes will give 75 bad accidents in 1908 as against 58 in 1907. Ninety-five per cent of these would be prevented by the use of an automatic engine stop having a speed limit device independent of the governor. This stop may be of the throttle type, an auxiliary valve near the throttle, or one on the column of the governor, so long as it acts independent of the governor. Devices used in conjunction with the governor served the purpose very well as automatic engine stops until the steam pressure ran up to 100 pounds and over and the speed of flywheel rims up to over 4,000 feet a minute. These new conditions render the older devices inoperative in many cases because they are too slow to work before harm is done.

In all cases those who have charge of installation of plants in buying machinery should specify that the speed limit device is to be run off the engine by a separate belt and is to be set to operate if the belt slips or breaks, and on 3 per cent over speed. This will do away with danger of flywheel explosions and will be found a good investment, for with such an outfit the engineer can stop his engine from a distance and she will never speed up enough to do harm. Last year 43 people were killed and a large number injured by flywheel explosions, and with the number of such explosions on the increase, as I am certain that it will be, it would seem the part of wisdom for every user of a steam engine to adope some good engine stop for the protection of life and property.

A peculiar case of trouble comes to hand of a plant in which for a 500-h. p. cross-compound condensing engine when running days, only one drop of cylinder oil for each 18 revolutions is sufficient; when running days and nights, sufficient oil can not be put into the high-pressure cylinder to keep the valves from groaning. The explanation seems to be that when running days only, the load is light and the boilers are working easily, but in the continuous run the entire plant is being forced hard and steam that comes over to the engines is very wet. This water in the steam collects the oil in globules so that but a comparatively small part of it reaches the surfaces of valves and cylinder.

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INDUSTRIAL EDUCATION

What is it? Why should all be interested in the subject? In the first place, spite of the Westminster catechism, the chief end of man is to make a living for himself and his family; then to help them enjoy that living. Just so far as he is fitted for that purpose and accomplishes it, he will increase earth's stock of happiness, and be happy. Anything that will better fit us or our children for this main purpose of life is worth while getting after.

Industrial education is trade education,—the teaching of trades, but that means, if rightly carried out, the teaching of many things besides hand work. To do good handiwork needs a head which knows what is to be done and how to go about it. The hand is the tool of the brain as much as is the hammer that of the hand. Clear thinking must come before correct working. But the surest way to train the boy or the man to careful, correct thinking is to have the thought put at work.

Most of us have to work for a living. If we had been so trained that we could do better work, we could make a better living, do it easier and be more use to our fellows. Industrial education is aimed at just this end. It is to give such training of mind and hand that a boy shall be a better workman, and therefore a better man. Not only that, but to give him a start and show him how to keep on educating himself for all his life, as he must do if he is to succeed.

An attempt is now being made by the National Society for the Promotion of Engineering Education to inaugurate a system of trade schools as a continuation of the public schools beyond the grammar grade. In these children will be kept up to the seventeenth or eighteenth year, giving part of the time to head training in such studies as will best help the hand training which will take most of the time. Also these schools will give special courses to those already at work and who can arrange for from 6 to 12 hours a week for such training. Lewis Institute of Chicago, Drexel in Philadelphia and Pratt Institute in Brooklyn are good examples of what such schools can accomplish. The thing is to get enough such schools so that anyone who wishes to enter a trade can find one reasonably near him.

Dr. Charles W. Eliot of Harvard in his address before the annual meeting of the society advocated the compulsory attendance of all who were fitted for a trade in these "continuation schools," as he called them. To avoid spoiling a lawyer in the attempt to make a machinist, he would have the teacher sort out the children according to the work that they can do best. If this can be done, it will certainly take a load of worry off the shoulders of fond parents, and it is likely that no more round pegs will be found in square holes than under the ordinary method of letting little Johnny start to be a doctor "so he can ride around in a carriage."

The situation and the need were well summed up

in a speech recently made at Memphis by Dr. Henry S. Pritchett as follows:

"And after all, the most pathetic part of this whole picture of industrial education is the situation of the American boy between the ages of 14 and 16. He has left the grammar school,—95 per cent of all our boys leave the grammar school before the age of 14; and from that time until he is 16 or 18 the only sort of thing he has open to him, as a rule, is to run an elevator or go on errands or take some other means of earning a living which is unproductive in the way of citizenship, unproductive in the way of character, unproductive in the way of skill.

"This is the question which lies before us, as I see it; how to get the boy, now so ill-trained, the boy who now spends 3 or 4 years in unproductive work, first into a school where he may get training, then into a shop where he may finish that training; and to do all this with such fairness, with such justice, with such consideration for all classes of our citizenship as may in the end bring about a solution which shall lend itself, not to the cause of industrial war, but to the cause of industrial peace."

LOOKING FOR LOSSES

Not only with the indicator, although that is a most useful weapon in fighting waste of energy, but with calorimeter and chemical analysis for the coal with flue gas testing with oil tester and with careful records of operation must the fight be waged if the chief engineer is to conquer and put his foe to utter rout. Systematic keeping of records is the first step, as it shows the effect of the various changes which may be made on coal consumption and labor cost.

The system as outlined in the article by Mr. Ould in this issue is a good model for anyone to follow, adapting the various blanks to his own system and plant. But the keeping of records, unless they be carefully studied to find the story that they tell, is simply a weariness to the flesh.

It's pleasant work taking diagrams from an engine and adjusting the valves to the finest possible point. That needs doing, for badly adjusted valves are usually steam wasters. Poor coal, bad firing, wrong air supply, leaky settings, oil unfitted for the bearings,—any or all of these may be as bad energy wasters and therefore money wasters as the steam devouring valve.

The measure of value of coal is the heat that may be developed from it. This fact is discussed in a paper by E. G. Bailey before the cotton manufacturers and he gives as the points that determine the value of coal, the per cents of volatile matter, ash, sulphur, moisture and fixed carbon. Comparing tests made on a series of coals, Mr. Bailey found that for a coal costing $4.40 a ton at the plant and having a heat value per pound of 12,834 B. t. u., the evaporation from and at 212 deg. F. was 8.8 lb., while a coal costing $4.60 with a heat value of 14,354 B. t. u. evaporated 9.93 lb. The former coal would be worth therefore, on a basis of evaporation, the same as the latter coal at $4.96 a ton. The more costly coal was therefore cheaper in the end.

On the other hand, a coal costing $4.86 and having a heat value of 14,533 B. t. u. evaporated 10.03 lb., and it would yield the same in value as the $4.60 coal if that were sold at $4.80 a ton. Here the cheaper of the two coals is the better to buy. A coal high in ash, sulphur and moisture is always expensive.

Evaporative tests are held to be more satisfactory than laboratory work with calorimeter and test tube. It is difficult, however, to get the lots of coal to be compared burned under like conditions. To get the best evaporation from each, requires a fireman skilled in handling both kinds of coal. There is always considerable guesswork, too, about weights used and condition of fire. Laboratory tests are exact and accurate, therefore reliable and from the calorimeter and test tube analysis, the value of coal can be determined within 1 per cent, which is closer than the probable errors of an evaporative test. Hence, although comparative tests under a boiler are good, the laboratory test is best used when checking a coal as to its heat value or against specifications. To be certain that the right coal is being used calls for regular, systematic analysis, both to prove the quality and for the effect on the coal dealer. Then, too, it may happen that the coal used is not adapted to the furnace, so that it is not giving the heat that might be gotten from it. In such a case, laboratory analysis shows what the coal should do, and gives a valuable check on actual performance.

Flue gas analysis with a record of uptake temperatures tells the story as to whether the firing is being well done.

Excess of air gives more complete combustion, but it also cools off the gases, which lessens the transmission of heat to the water. Dirty heating surfaces on either gas or water side are a cause of loss that can and should be avoided. With clean surfaces a smaller amount of heating surface is needed, as heat is transferred more rapidly. If heat passes rapidly, most of it will be given up to the water while the gas is at high temperature, hence, at high efficiency of transmission.

Good lubrication is one of the important means to prevent loss. By systematic tracing out of losses in shafting and machinery and use of suitable oils, William F. Parish, Jr., has been able to save from 2.5 up to 24 per cent of the power used in a mill. His system is elaborate, but in a simplified form may be adopted by any engineer having an indicator. By trying different oils for the various bearings and measuring the power of the engine it is possible to determine which oil is best suited to the mill requirements. Some of the figures given by Mr. Parish are interesting as showing what may be done. In an American cotton mill the horsepower was reduced from 543.2 to 471.8;

in an English cotton mill from 1408.6 to 1301.8; in an Irish linen mill from 110.7 to 93.1; in a Russian cotton mill from 1238.8 to 1069.1; in an English paper mill from 465.4 to 390.4; in an English wood shop from 84 to 65.3.

Such reductions mean saving in the coal bill, in the feed water used, a reduced temperature of bearings which permits of speeding up if desirable, fewer stoppages from hot bearings and less frequent repairs for the engineer to make. Increase in the size of the power plant may be avoided and sometimes a spare unit secured by laying off an engine or boiler. It is therefore worth while for the engineer to carry his hunt for losses all through the plant wherever power is used.

A systematic hunt is necessary if anything is to be accomplished; a haphazard try now and then may find a loss, but to find them all needs a regular organized search, taking each possible hiding place for a loss and examining it carefully. Few plants but what will yield good returns for such a search, in the form of smaller coal and oil bills and less work required to care for the machinery. After all losses are located, and eliminated, a careful system of records keeps tab to see that the loss evil does not creep back.

EDITORIAL CHAT

The Tungsten Filament Lamp

THERE may be nothing new under the sun, but new things are doing under the moon. For years everybody said the carbon lamp was the only possible thing. Now we have all kinds of lamps: the Tantalum lamp, the mercury vapor lamp, the metallic filament lamp and the last comer, the Tungsten lamp, which looks very much as if it would beat all the others and put them on the retired list in a few years.

The National Electric Lamp Association, which comprises pretty nearly all the incandescent lamp manufacturers in the country, has an engineering department that does nothing but hunt around for new ways of making lamps and new facts about lighting. This department has just put out a mighty attractive and interesting little pamphlet about this same Tungsten lamp, and with thanks to them rather than apologizes to anybody, we propose to quote considerably at length from it.

"'All human souls love light,' wrote Carlyle. And to dispel the darkness 'twixt sundown and sunrise, each epoch of civilization had its mode of artificial illumination.

"Heaping high the brushwood, the aborigine sat in the glow of the campfire; it gave warmth, protection from the perils of the wilderness—and light.

"At the extremes of the earth the Eskimo and Patagonian rendered fat—for light; and the Indians of the Caribean wrote their hieroglyphics by the phosphorescent light of the sea. Even the age of Pericles, with all its culture, produced nothing much better than the torch. The Saxon King Alfred was immortalized—for inventing a tallow-dip. Then there is a gap of many centuries.

"Comes gas—and under that weird, mysterious light the world gropes about. Gas holds sway—and the flickering oil lamp.

"And then, of a sudden, we find ourselves in an electrical age!

"Today, light—just light, is not sufficient.

"Through the long hours of artificial light we have hungered for the natural sunshine.

"Efforts to still this yearning produced marked improvements in the quality of electric light. But that was not enough. The search went on."

The Tungsten lamp is the final achievement. It is the first artificial light by which colors can be fully distinguished. A year ago it was a laboratory affair, now it is a standard commercial article. The bulletin of this engineering department about the Tungsten lamp tells a lot of things. First, that the lamp is made in 32 and 48 nominal candlepower sizes, second, that the nominal watts per candlepower are 1.25, as against 3 to 35 for the carbon filament, 2.5 for metallic filament, and 2 for the Tantalum. Third, that the Tungsten lamp will burn for 1,000 hr. as against 600 for the high efficiency carbon, 560 for the metallic filament and 1,200 for the low efficiency carbon, and an average of 1,500 for the Tantalum. Fourth, that the kilowatt hours used up by a 32-candlepower lamp during its life will be, for the carbon, 153 for the high efficiency and 137 for the low efficiency, 57.5 for the Tantalum, 128 for the metallic filament, and 40 for the Tungsten. This certainly makes a pretty showing for the Tungsten lamp. The only trouble with it is the cost, which is $1.20 each for the 32-candlepower, as against 24 cents for the carbon, 28 cents for the metallic filament and 68 cents for the Tantalum, but the Association's engineers claim that all the same, the saving in power, longer life, etc., make it a cheap article to have in the house.

After figuring backwards and forwards and crosswise, they make out the case as follows, between the different kinds of lamps, and it is probably right, because, as all the companies make all kinds of lamps, there is no reason why they should boom one any more than another, except on the actual facts. They say that when power costs more than 2 cents per kilowatt-hour the Tungsten lamp is the cheapest, when you count up everything, with the exception that on 60-cycle alternating current the Tantalum lamp has the best of it in high candlepowers up to 2.5 cents per kilowatt-hour on alternating current, and up to 4 cents per kilowatt-hour on direct current. Since there are mighty few places where current for lighting does not cost more than 2.5 cents per kilowatt-hour, it looks like the Tungsten lamp was going to be "it."

If any of you have any lighting to install, it is worth while to get the bulletins Nos. 6 B and 7 of

the Electric Lamp Association, which can be had by writing to the Engineering Department at Cleveland. No. 6 B gives all kinds of figures about the Tungsten lamp, and No. 7 is full of facts about illumination, showing the effect of colored lights on colors, the color of different kinds of lights, the size of lamps and the distance from objects to give the right kind of lighting for all sorts of places, and a lot of other things which are needed in putting in a lighting system.

THE VALUATION OF A STEAM POWER PLANT

Conditions under Which Condensing and Non-Condensing Engines Should be Used

THE determination of the value of an operating power plant involves the consideration of many factors. It is seldom that they are more critically considered or more clearly presented than in the following extract from a paper by Mr. Charles T. Main:

The value of a steam power plant will depend upon its character and its condition; and its condition depends very largely upon the service which it has rendered.

With good water and good care, running about 12 hours a day, the life of a boiler should be about 20 years, or the depreciation 5 per cent. a year. Slow-speed engines, running 10 hours a day, can be estimated as having a life of about 25 years, or a depreciation of 4 per cent. a year. High-speed engines are much shorter lived, and will not average over 15 years, or a depreciation of about 7 per cent. a year; and oftentimes it is greater when run 10 hours a day. The depreciation when run 20 to 24 hours a day is correspondingly greater. Boiler settings and piping should be included with the boilers, and engine foundations and pipings with the engines.

The life of economizers varies with the initial temperature of the entering water from about 10 years up to 40.

The proper type of engine to use depends upon the use which can be made of the steam after passing the engine, and if the most economical plant commercially is not installed, the purchaser must make such allowances as will make good to him the difference in running expense over and above what a new plant would cost him to run.

If steam is to be used for power exclusively, the compound or triple-expansion engines of proper designs are the most economical, and for mill work the compound is the more common of the two.

If more or less low-pressure steam is required for other purpose than power, this type in a special form can be used to advantage, except in such cases as require nearly or quite the same amount of low-pressure steam as would be exhausted from the engine producing the amount of power required. Such a condition as this might exist where small amounts of power and large amounts of low-pressure steam are required, as in a dye house or printery, or in case a portion of the power is produced from water, and the other portion from steam, the power of the latter being such as to supply the required amount of exhaust steam for the various purposes to which it is put.

In such cases as these it would be absurd to add a condensing cylinder to the engine, and then supply the low-pressure steam direct from the boilers through reducing valves. The proper type to use here would be the simple or compound non-condensing engine.

Between these 2 extremes of steam used for power only, and an amount of low-pressure steam used equivalent to the whole amount exhausted from the engine, lie nearly all the cases of ordinary practice.

If an amount of exhaust steam can be constantly used up to about 75 per cent of the whole amount exhausted from a high-pressure cylinder of a compound condensing engine, the most economical plant to put in would be a special form of compound condensing engine taking this steam from the receiver; but if more than 75 per cent of the exhaust could be used for heating purposes, then the proper type would be the noncondensing.

If the amount of exhaust steam used were a variable amount, but averaged more than would allow for equal cylinders on a compound engine, the proper type of engine to use would still be the noncondensing. If the average of the variable amount fell below that amount which would allow for equal cylinders on a compound, then the proper type to use would be the compound condensing engine.

There is one advantage of the compound condensing over the noncondensing engine with variable amounts of exhaust steam used, viz., the low-pressure cylinder, being arranged for a variable cut-off, can control the variation, thus making use of all the steam, decreasing the amount used in the high-pressure cylinder, and preventing any wasteful and unpleasant blowing-off of exhaust steam.

The practical limit of the average proportion of exhaust steam which can be used and still employ the compound system, when the quantity required is variable, is when that proportion requires equal cylinders on the compound engine; and this limit is established by the ability to control the steam exhausted from the high-pressure cylinder.

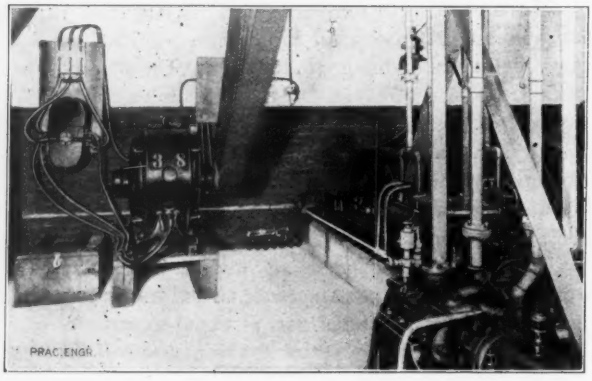
CONSUL-GENERAL RICHARD GUENTHER, of Frankford, says it is reported that a Hamburg joint stock company has purchased a large tract of land along the mouth of the Elbe at Cuxhaven, where power works are to be erected. The action of the ebb and flow of the tide is to be employed in generating electric energy to be used in factories about to be established. The works will also furnish electric power in the town of Cuxhaven and other towns in the vicinity. The daily capacity of the plant will reach 14,000 h. p. Tests are said to have established the feasibility of this method of generating electricity.

ELECTRICAL MACHINERY AND APPARATUS

ECONOMY AND CLEANLINESS IN PACKINGTOWN

ELECTRICITY AN IMPORTANT FACTOR

WHATEVER may have been the conditions that inspired the writing of "The Jungle," with its plainly exaggerated account of the state of "Packingtown," there is nothing in or about the stockyards of today, and their manifold industrial plants, teeming with operatives, to even faintly suggest the revolting scenes of filth which Sinclair's lively fantasy pictured. On the contrary, all indoors is the product of an order, good system and cleanliness almost beyond belief, and one of the most potent factors in bringing this about has been the introduction of electric drive, with its consequent clear head room, free floor space, better light, ventilation and operating conditions than



40 H. P. INDUCTION MOTOR DRIVING 6 VACUUM PUMPS

could ever have been possible under the old system of shafting, belting, pulleys and gears innumerable, which formerly stretched in a network across each room, "cluttered up" the place and gathered dirt and waste on every exposed surface.

The extent to which motors are now utilized and their widely diversified application was shown in a recent visit of the writer to the various Chicago plants of Swift & Co., and Libbey, MacNeil & Libbey, where machines to the capacity of about 9,000 h. p., in sizes from 1 h. p. up, are in daily operation.

Strange and queerly-named apparatus, which the average man never heard of and probably would not understand, such as rockers, plotters, candlers, crimpers, crutches, neutralizers, etc., are all driven by motors, while hydraulic presses, small pumps of every conceivable description, fans, blowers, elevators, conveyors, separators, hoists and machinery of general utility are electrically operated in all departments and throughout the yards. Then there are the numerous motor-driven tools in the boiler-shops, where tanks are made for plants and cars, the woodworking and carpentry shops, machine and general repair shops, and apparatus installed in the coal sheds, power houses, refrigerating plants, ice houses, warehouses, office buildings, laundries, restaurants, and elsewhere —all run by electric power.

Of all the numerous establishments which have transformed Packingtown from a collection of slaughter houses into one of the most varied and extensive industrial communities to be met with anywhere in the world, none is more typical of the best modern practice, both mechanically and from a sanitary standpoint, than that of the nine-story "Kitchen" of Libbey, MacNeil & Libbey, where the famous canned corn-beef, potted tongue, boneless chicken and other delicacies are prepared for shipment to all quarters of the globe.

Meat from the adjoining slaughter house, after being cut into suitable lengths and thoroughly cleansed, is brought to this building by an elevator (or, if corned beef, lifted from the pickle-curing cellar) and transferred in buckets on trolleys, to the cooking room, which occupies the ninth floor, equal in area to a thousand household kitchens. Here may be seen at a glance the feature which is characteristic of this plant, viz: absolute cleanliness. The walls are faced with pure white enameled brick, the ceilings and floors are of concrete, the window sashes shine with polished metal and there is not a piece of wood either in this or the other rooms to be described.

From the cooking room, meat is sent on enameled conveyors to large white tables in the trimming room on the eighth floor, where it is put in shape for the tins. Flesh representing over two hundred and fifty cattle can be trimmed here in an hour, with the aid of five meat choppers, each direct connected to a 2 h.p. motor.

The seventh floor is known as the square-canning room, where corned beef is put up. Four stuffing machines, each driven by a 5 h. p. motor. and three capping benches, each taking its power from a 2 h. p. motor, constitute the principal apparatus used.

On the sixth floor is the round-canning room, filled with stuffing machines and capping benches driven in the same manner as those above described.

Both are supplied with vacuum pans, enabling the cans to be sealed in vacuum, and the six American Air Compressor pumps installed for this service in an adjoining room, are all driven by belting from one

40 h. p. motor. The various conveyors used in these rooms have each one ½-h. p. motor direct connected.

All of the motors operate on alternating current and are of the squirrel-cage induction type built by Allis-Chalmers Co., Milwaukee, Wis. These offer especial advantages for the service, being very simple in construction and easy to keep clean.

All of the stories have numerous windows, and, with the absence of overhead gear of any kind, good light and ventilation are secured, making the entire plant, with apparatus, such as described, a veritable triumph of sanitation. What part the use of motors plays in this, the reader will readily understand. All tables, trucks, instruments, etc., are in keeping with the rest of the establishment, there being nothing that will absorb moisture, and every fixed piece stands on legs high above the floor, enabling the latter to be thoroughly flushed at the close of each day.

A total reaching many hundreds of millions of dollars is realized each year from the sale of packing-house products, including fresh beef, mutton, pork and veal, corned beef, tongues, ox tails, hams, bacon, lard, poultry, eggs, butter, butterine, soaps, tallow, glues, oils, bones, fertilizers, pelts, hides, casings, wool, hair, feathers and various other byproducts derived from cattle, sheep, hogs, and poultry.

The industry is operated on a very narrow margin, and, as there are no secret or complicated processes not open to all, packers such as Swift & Co., Armour & Co., and Nelson-Morris Co., must depend for their very existence, as large corporate concerns, upon such advantages as location at the chief live stock centers, manufacturing in large quantities at the minimum of expense, good refrigeration, utilization of all waste material, and highly efficient business management, including the use of the very best mechanical methods and appliances. It is here that motor-drive has been taken up with such notable results, particularly in the conversion of "waste" into dollars; for, were it not for the so-called byproducts, there would be, under present conditions of trade, not only small profit, but an actual loss in the handling of meats from live animals.

SPECIAL TRANSFORMER APPLICATIONS

CONNECTIONS TO GIVE ODD VOLTAGES FROM TRANSFORMERS WITH STANDARD WINDINGS

By H. W. Young

SOME uses of standard transformers which have come to the writer's attention are likely to be of use to others in emergencies.

A company, operating a plant supplying both railway and lighting service, had an opportunity to supply current to a small town located about 4 miles from the company's power house. In order to secure

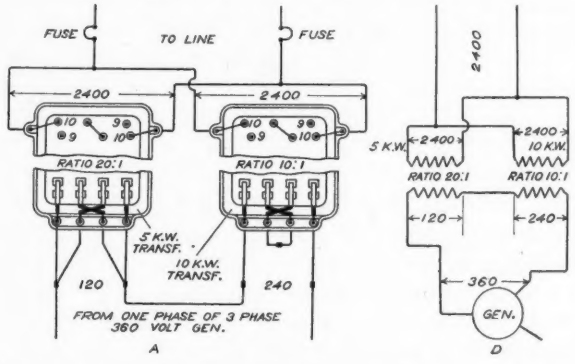


FIG. I. CONNECTIONS OF 20 TO 1 AND 10 TO 1 TRANSFORMERS FOR GETTING 2,400 VOLTS FROM 360; A ACTUAL; D DIAGRAMMATIC.

this customer it was necessary for the operating company to supply current within 4 days of the date of application, as the small local lighting plant of the town had broken down and in view of this the business was offered to the power company on condition that service could be obtained within the time specified.

Lights From a Railway Circuit

The available source of power was a 360-v., 3-phase 60-cycle generator supplying current through rotary converters to a railway line and through step-up transformers having 360-v. primaries and 11,000-v. secondaries to a town 10 miles distant. Upon inquiry the local manager found that it would require 45 days to secure a transformer with 360 v. primary and 2.200 v. secondary, and 60 days to secure a transformer having 11,000 v. primary and 2,200 v. secondary. In order to secure the town lighting it was only necessary for the operating company to supply 15 kw. at first, which would take care of the lighting of a public building, but even in this small capacity quick delivery of transformers having a special primary of 360 v., or one having a high tension primary of 11,000 v. appeared to be out of the question.

This problem was easily and quickly solved in the following manner: A standard transformer at 120 v., low tension, with a 20 to 1 ratio, or 240 v. with a 10 to 1 ratio gives 2,400 v. high tension. (These voltages are, of course, considerably higher than normal, although permissible in cases of emergency.) It was seen that 120+240 gave 360; that is, if two transformers were used with their high-tension windings in parallel for 2,400 v. and their low-tension windings in series, one connected for 240 and the other for 120 v., the group would operate at a ratio of 360 to 2,400 as desired. Therefore, the connections were made on the transformers as indicated in Fig. 1A and dia-

grammatically in D. It may be noted that full-load current for the 10-kw. transformers at 240 v. corresponds to the current of the 5kw. transformers at 120 v., thus permitting the operation of the transformers in series on the low-tension sides as indicated.

The ease with which this problem was solved led to the question of how many special applications could be adapted to the regular types of transformers, and the following examples were worked out which may be of service to those called upon to meet similar emergencies:

Parallel-Series Connection

1.—Required 7.5 kw. at 500 v. from a 60-cycle, 1,000-v. circuit with standard transformers available. As the high-tension voltage of the standard 1,050-v. transformer is substantially that required, and the frequency normal, the problem becomes one of determining a method for obtaining the 500 v. secondary. This may be obtained by connecting 2 transformers in series, the sum of whose voltages will be that desired, say 400 and 100. If, then, a 5-kw. transformer connected, as shown in Fig. 2 for 1,000 to 400 v. be used with a 1.5-kw. transformer with a ratio of 1,000 to 100, the low tension windings in series will yield 500

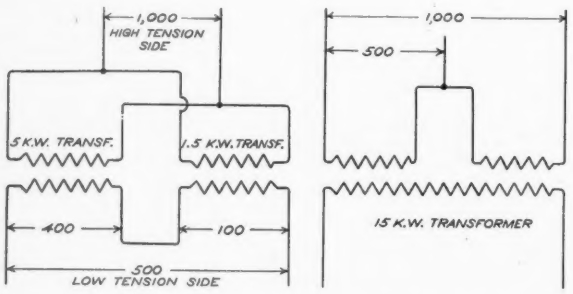


FIG. 2. 500 VOLTS FROM 1,000 BY USING 2 STANDARD TRANSFORMERS

FIG. 3. 500 VOLTS FROM 1,000 BY USING THE HIGH-TENSION WINDING AS AN AUTO-TRANSFORMER.

v. and the high tension windings in parallel 1,000 v., as desired.

On the low-tension side the current required is 15 amperes (500×15=7.5 kw.) which is the normal current for the 1.5-kw. unit, but corresponds to a 6-kw. unit with a 400-v. secondary; that is, the 5-kw. unit will be overloaded 20 per cent. That, however, is permissible, especially as the iron loss is considerably reduced due to the lower voltage.

Instead of the 5-kw. unit in the foregoing case, 2 3-kw. units might be connected at a ratio of 1,000 to 400 with both high-tension and low-tension windings in parallel and these in turn connected in series on the low-tension side with the 1.5-kw. above referred to and in parallel on the high-tension side.

A further method would be to employ a 15-kw. transformer using only the high-tension winding. In this case 1,000 v. would be impressed over the high-tension winding when 500 v. could be taken from one-half of the winding, as shown in Fig. 3. In this case, however, the 1,000 and the 500-v. circuits are electrically connected which may not be permissible.

Three-Phase Delta to Star

2.—Required 250 v. for starting and 400 v. for running a 3-phase, 20-h. p., 60-cycle motor from a 1,150-v. line. To supply a 20 h.p. motor will require approximately 20 kw., which, in 3 transformers, cor-

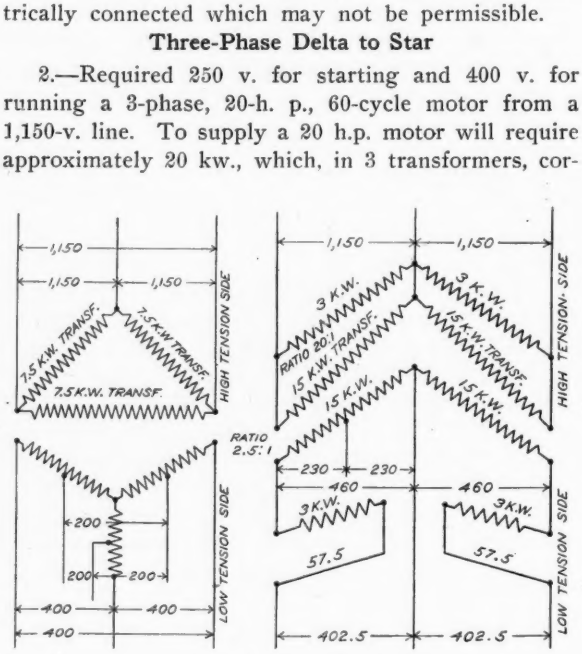


FIG. 4. 200 AND 400 VOLTS FOR INDUCTION MOTORS FROM A 1,150-VOLT LINE.

FIG. 5. 230 AND 400 VOLTS FROM 1,150 BY TRANSFORMERS WITH SECONDARIES OPPOSED

responds to approximately 3 7.5 kw. units. If these are connected to give a 5 to 1 ratio, 1,150 v. on the primary will give 230 v. for the secondary. If the transformers are connected with the high-tension windings in delta and the low-tension windings in star, as shown in Fig. 4, the ratio of the 3-phase transformation will be 1,150 to 400 as desired, and by using the middle point of the low-tension windings, 200 v. will be available for starting the motor.

Primaries Parallel, Secondaries Opposed

As another solution, 2 15-kw. and 2 3-kw. transformers may be connected in "V" with 1 15-kw. and 1 3-kw. transformer on each leg, as shown in Fig. 5. With 1 of the 15-kw. transformers connected with a ratio of 2.5 to 1, 1,150 v. high-tension will give 460 v. low-tension. The 3-kw. transformers should then be connected to give a ratio of 20 to 1, so that 1,150 v. will give 57.5 v. low-tension. If the 15 and the 3-kw. transformers be connected in parallel on the high-tension side to the 1,150-v. line and put in series on their low-tension windings, so that the 3-kw. transformer winding will oppose that of the 15-kw. transformer, the resultant voltage will be 460-57.7 or practically 400 v. The middle point of the 15-kw. low-tension transformer gives 230 v., which is fairly close to that desired for starting the motor.—The Electric Journal.

ABSORPTION REFRIGERATING MACHINES*

By Heywood Cochran

MANY are inclined to look upon the absorption system as something complicated and mysterious, and yet nothing could be more simple. Perhaps if I liken it to any ordinary boiler plant, I can make this clear to you. The generator is the ammonia boiler where the fuel used is steam in the coils instead of coal and amomnia gas is generated instead of steam. The ammonia pump is simply the boiler feed pump. The exchanger is merely the feed water heater, heating the cold strong aqua before it goes into the ammonia boiler. However, it serves the double purpose of cooling the hot weak aqua, at the same time, before it returns to the absorber, ready to again pick up a fresh charge of gas. The rectifier is nothing but a drier and serves the same purpose as a separator on a steam line, although in a different way.

The system derives its name from the strong affinity or attraction existing between ammonia gas and water. The colder the water is the more gas it will absorb, for instance, at a temperature of 50 deg. F. 1 part of water will absorb 900 parts of ammonia gas by volume, while at 100 deg. F. it can absorb a little over one-half as much. Therefore, the colder the cooling water, the less cooling surface is necessary. It is for this reason that it is so especially important to know the temperatures of the condensing water in advance, so as to properly proportion an absorption machine.

Starting with the condenser and until the expanded gas is ready to be removed from the expansion coils, the absorption system is the same as the compression. Instead of the gas, however, being drawn out of these coils by a suction and compression pump, it bubbles up through the weak aqua in the absorber, being absorbed as fast as it enters and changing the weak to strong aqua. As weak aqua is constantly entering the top of the absorber and strong aqua being pumped out at the bottom, the absorption process is continuous. Cooling water is passed through coils or tubes in the absorber to remove the heat produced by the absorption of the gas and to keep the aqua cool so that it can absorb as much gas as possible.

Then the cold strong aqua is pumped through the rectifier, or drier, on through the exchanger, or feed water heater, into the generator, or ammonia boiler. The heat of the steam in the generator coils drives off the ammonia gas, which passes through the rectifier or drier to the condenser, where it becomes liquid anhydrous ammonia ready to be again expanded. The hot weak liquor is forced by the head pressure from the bottom of the generator through the exchanger, on through the weak liquor cooler into the absorber. There are then two distinct cycles, the strong and weak aqua being one and the gas or liquid anhydrous ammonia the other.

The fact that it is the heat of the steam rather than the expansive force that is principally used and that both the expansive force and the heat can be used, is the greatest advantage the absorption machine possesses over the compression. Remember that a steam boiler only utilizes from 60 to 70 per cent of the heat in the coal burned under it, the balance going up the stack and being lost in radiation. This is bad enough, but when the steam is expanded in the engine of a compression machine, only about 10 per cent of this 60 to 70 per cent is used, the balance being lost in the exhaust, save for the little used in heating feed water.

In the absorption machine the steam can be actually condensed in the generator coils and all the heat utilized, both sensible and latent. And if not needed for ice making purposes the condensed steam or distilled water can be pumped back into the boiler and all its remaining heat used.

Another great advantage the absorption machine has is its wide range of efficiency. To produce brine temperatures of 15 degrees below zero F., the absorption machine loses only 10 per cent from its point of maximum efficiency, while the compression machine loses over 70 per cent. Absorbers are usually operated on from 0 to 10 pounds' pressure, but the weak aqua absorbs practically as much gas when operated with a vacuum as with these higher pressures. It is the ability to get these very low back pressures economically that makes low temperatures so easily obtained.

Then take the question of head pressure; it takes very little more steam in an absorption machine for high head pressure than it does for lower ones. Think of your boiler plant again. It doesn't take much more coal to produce the same horse power of 125 lb. steam than it does to produce 100 lb. steam. There is, of course, some difference, but it doesn't amount to a great deal. The ammonia pump has to work against a higher pressure, but as the amount of steam required for it is only about 10 per cent of the total amount used, this additional amount is almost negligible.

Now let us turn to the compression machine and see how variations in head and suction pressures affect it. The capacity of a compression machine is based on a suction pressure of 15.67 lb., at which point the gas is 0 deg. F. The number of cubic inches of cylinder displacement varies from 7,000 to 8,000 per ton of refrigeration in different machines, but in any one machine it is unalterably fixed. If the suction pressure becomes less than 15.67 lb. the gas becomes lighter, less gas is handled and the capacity is reduced. If the pressure becomes higher, the gas becomes denser,

*Abstract of a paper read before the Western Ice Manufacturers' Association.

more pounds of it are handled and can be expanded and the capacity is increased. It is for this reason that compression machines are more advantageous where high suction pressures and temperatures can be carried, than they are for lower ones.

In a paper on this same subject, read before the National Ice Carnival at the Jamestown Exposition last fall, I prepared a table showing the number of pounds of steam required by compression machines per ton of refrigeration at varying head and suction pressures, which admirably illustrates this point. This table is based upon tests made by Thos. Shipley. It shows the steam required per horse power-hour for a simple Corliss engine is taken at 26 lb.; for a compound noncondensing engine at 22 lb., and for a compound condensing at 15 lb. These figures are conservative and are about 10 per cent less than would probably be met with in practice. With 185 lb. head pressure, 60.189 lb. of steam is required per ton of refrigeration per hour with 5 lb. suction pressure; 51.428 with 10 lb.; 44.446 for 15.67 lb., the normal rating; 39.947 for 20 lb., and 35.79 for 25 lb. When you remember that builders of modern absorption machines will guarantee that the ammonia pump and generator, which together correspond to the compressor, can be operated on from 30 to 35 lb. of steam per ton of refrigeration per hour, you can appreciate the differenec between the two systems. And this is for the simple live steam machine. When the expansive force of the steam is first used for power purposes, and the heat used afterward in the generator as in an exhaust steam machine, the difference is much more marked.

Despite all that is said to the contrary, the absorption machine is simpler and easier to operate than the compression, provided one doesn't consider it something mysterious and follows simple instructions. And the wear and tear is less, for the ammonia pump, the only moving part, makes from 20 to 25 r. p. m., while compressors make from 50 to 150, depending upon the size. With the regulating devices now used the absorption machine requires practically no attention, and its owner need not be afraid of hot bearings during his absence.

One point that has always been strongly urged against the absorption machine by compression advovocates is the amount of condensing water required. That was true formerly, when submerged condensers were used, and is still true with some types of the system, I will frankly admit. But with the modern absorption machine not one drop more water is required in a can ice plant per ton ice making than with a compression. This has been affected by the use of double-pipe condensers, which have much less work to do than in a compression plant, as the gas has been cooled to a considerable extent by the cold strong aqua in the rectifier before reaching the condenser. Then as a good part of the steam is condensed in the generator, very little water is required for steam condensing purposes. Compression advocates will make all kind of claims on the water question, but when they are pinned down and made to put their water consumption in black and white in a contract it is quite a different matter.

Regarding the life of an absorption machine, the mere fact that there are still so many Blymyer machines in active operation, the manufacturer of which passed out of existence 16 yr. ago, is a pretty good reply to the statement that they are short lived. I believe that the absorption machine will longer give its full capacity and over, with less attention and repairs than a compression. In the latter there are valves to wear, both in the engine and compressor; brasses to wear, increasing the clearance in the compressor, and oil to contend with in the expansion coils, reducing the efficiency of the plant. The careful engineer will of course keep his compression plant in good order by overhauling it every winter, remedying these points.

It is not my intention to say there is never any trouble with the tubes or coils of an absorption machine, especially where the condensing water is corrosive, absorber tubes will give way, just as will boiler tubes, but a great part of such trouble can be avoided if the plant is gone over at the close of the season, with one-half the care and expense put on the well cared for compression plant. And even if absorber tubes do give way in mid-summer, this need not shut down the plant, for they can be plugged up.

In the question of supplies such as ammonia, oil and waste, much less need be spent with an absorption machine than with a compression. The ammonia leakage does not average more than one-half as much, as no piston rod has to be packed against gas. As for oil, practically none is used, there being none on the ammonia side and only a very little required for the small ammonia pump.

It is in the exhaust steam machine that the great future of the absorption system lies, and it is this that will lead to the overthrow of the compression. I know of one case now where 35 tons of refrigeration are being obtained in an absorption machine, from the exhaust of two 12-ton refrigerating compression machines. The small compressor engines are slide-valve, however, and afford more exhaust than the average plant would supply.

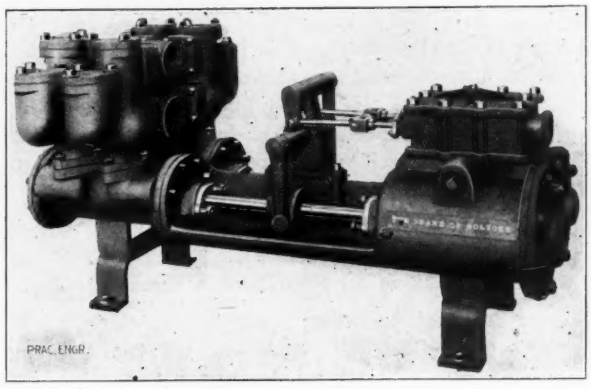
The exhaust steam proposition is an interesting one, but will say frankly that I do not believe in its indiscriminate application. With condensing water of 60 deg. F. there are a good many machines running from 2 to 5 lb. exhaust steam. With condensing water of 80 to 85 deg. the high head pressure required to condense it makes necessary steam pressure of from 20 to 30 lb. Even with cold condensing water it is safer to figure on 5 lb. pressure.

From the above you will see that it would hardly pay to put this back pressure on a large engine to run a small absorption machine, for more live steam would be required than if used in the engine and refrigerating

machine separately without back pressure. It is also difficult to work satisfactorily where the load on the engine is very variable.

NEW BOILER FEED PUMP FOR HIGH PRESSURE.

The accompanying photograph illustrates a type of pump which is rapidly coming into favor for feeding boilers against high pressure. The steam pressures of from 150 to 200 lb., which are in common use at the present day, require a more substantial construction of feed pump than the lower pressures of a few years ago. These machines are designed for high pressure and for handling either hot or cold water. The steam ends are made extra heavy and provided with extra strong bolting for all joints, making them suitable for constant operation under steam pressures up to 200 lb. per sq. in. The water ends are of the piston pattern pot valve type, and are of ample strength for



PISTON PUMP OF POT VALVE TYPE

working pressures up to 200 lb. per sq. in., and will easily stand test pressures of 300 lb. per sq. in.

The piston pattern construction requires less room than the outside packed machine of either the center packed or end packed type, and, furthermore, does away with the large outside stuffing boxes and the excessive amount of drip which usually accompanies the same. The pistons are fibrous packed, and are readily accessible on removal of cylinder heads. The valves are in special valve chambers or pots, located above the cylinders. This arrangement provides for constant submergence of the pistons and the reliability of action of the machine consequent to such submergence.

Each pot contains one suction and one discharge valve, each valve having an individual cover, easily removable for inspection. Valves are of best composition, of the wing guided type, with bevel seats, and are of ample area for the requirements of the service. A manifold connects the suction openings of the various pots to a common suction inlet and another manifold provides a common discharge outlet.

These pumps are high class machines of substantial construction throughout, and can be fully depended on for continuous service under the most severe and exacting conditions. While designed primarily for boiler feed purposes, these pumps are desirable machines for general service against pressures not exceeding 200 lb. per sq. in. A full line of sizes for boilers of from 200 to 5,000 h. p. is manufactured by the Deane Steam Pump Co., Holyoke, Mass.

BOILER SCALE AND ITS PREVENTION

It is seldom that information regarding the cause and formation of boiler scale, its effects and the best means of its prevention are more clearly presented than in the following extract from a report rendered some time since by Arthur D. Little, chemist, of Boston, to one of his clients:

"All water, especially surface waters, contain more or less mineral matter in solution which remains in the boiler as an encrustation when the water is boiled away or converted into steam. The mineral ingredients most commonly found in water and which cause the formation of boiler scale are the salts of calcium and magnesium. When the water is converted into steam these substances gradually separate out from the solution in the form of deposits and coat the inner surface of the boiler with scale.

"Scale formation is detrimental in several ways. It is a nonconductor of heat and the fires must, therefore, be driven harder to accomplish the same results. The water becomes separated from the boiler plates and these latter become overheated and are gradually burned out. The tubes and feedpipes of the boiler become more or less clogged and consequently become less efficient. Some of the scaleforming ingredients, especially magnesium chloride, also exert a corrosive action upon the iron.

"The aim of a boiler compound is to convert these substances into insoluble compounds which settle in the form of sludge or mud and can be removed from the boiler by blowing or washing.

"We could prepare a list of nearly 200 materials which are known to have been used for boiler cleaning purposes, but there are only four of these which are worthy of mention. They are: soda ash, or sodium carbonate, caustic soda, tannin and kerosene.

"Soda ash is an alkali and will neutralize any acid in the water, and also precipitate salts of lime, magnesia, iron, and alumina, in the form of soft sludge, which can be easily removed when the boiler is cleaned.

"Caustic soda is also an alkali and neutralizes acids and aids in the precipitation of the various salts.

"Kerosene is used in connection with the above to prevent foaming or priming.

"Tannin is also used to prevent foaming or priming, and will precipitate certain mineral matters, although it is not so efficient in this respect as soda ash or caustic soda."

LETTERS FROM ENGINEERS

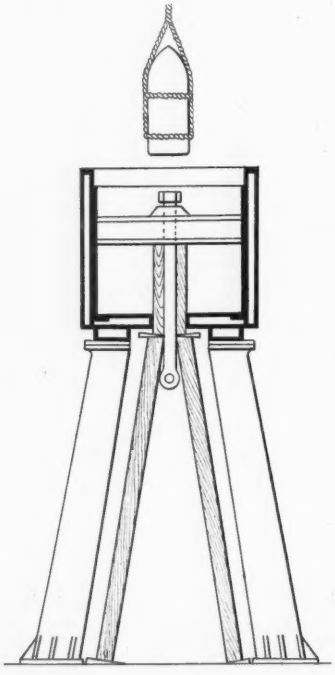
Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

Novel Method of Removing Piston Rod

Editor Practical Engineer:

While my ship was laying in Hong-Kong harbor, the H. M. S. Amphrite came in from Cheefoo, after running 12 hr. under forced draft. She kinked her low pressure piston rod, on the starboard engine, and it was my good luck to witness the finishing touches of removing the rod. They first tried this scheme:

Removed low-pressure cylinder head, put low-pressure crank on top center, removed the bull's eye on bottom of cylinder, and put two blocks of wood in the cylinder, one each side of the rod, but left them about 6 in. short from touching the piston. Then they slacked the piston nut about ¼ in. from piston, and put in the steam-jacking gear. They jacked the engine over, till the piston rested on the blocks of wood, but it was no use. They put the low-pressure crank back on the top center and speeded up the jacking engine, but it never budged the piston, always stopping when the piston hit the blocks.



PROJECTILE SUSPENDED OVER PISTON

One of the engine room force, called by his shipmates "Feedpump Bill," thought of a plan which he told the chief engineer, and he got permission to go ahead. He put the low-pressure crank on top center and braced the piston tight from the bottom of the cylinder, close on each side of the rod, with two long blocks of wood and wedges. Then he disconnected the connecting rod from the crosshead, and swung the connecting rod clear. He braced the bottom of the cylinder to the heelplate by two long beams and wedges. Then he rigged up a dummy projectile weighing about 280 lb., over the piston with a block and line. Next he made a sheet iron furnace on top of the piston, and built a fire in same. When he got the neck of piston hot enough to suit him he knocked the furnace away, and had the projectile hoisted and dropped onto end of piston rod. He made four attempts before he succeeded in jarring the piston rod loose, and as the nut was backed only ¼ in. the rod could not go far. He was highly recommended by the chief for his mechanical ability, though the idea is old; as can be seen by the sketch, the rod can not go through the cylinder on account of the crosshead.

F. C.

Relief Valve on Feed Line a Necessity

Editor Practical Engineer:

An engineer friend of mine was awakened to the fact that a relief valve on the heater or in the feed line is a necessity, especially when pumping the feed water through a closed heater into the boiler. As a general rule, when 6 o'clock comes, he has everything arranged so that when the whistle blows he stops the engine, puts his coat on, and goes home. This night, just before 6 o'clock, he was asked to keep the engine going for 20 min. longer. He had some minutes before stopped his feed pump and closed the valves in the feed line to the boilers. Now that he had to run for 20 min. longer, he decided to give the boilers a little more water, as he did not wish to leave them with less than 3 gages. He found, however, when he went to the valves on the feed line that he could not open them by hand, although he never had any trouble in opening them before, and it now took considerable force on a 12-in. monkey wrench to get them open.

This seemed mysterious, but after digging down deep into his think-it-out, it was easily explained. The pump had been running quite fast just before he had stopped it, with the result that the water did not have time to get very hot, and when he stopped the pump and closed the feed valves the water in the heater was still taking in heat, due to the fact that the exhaust

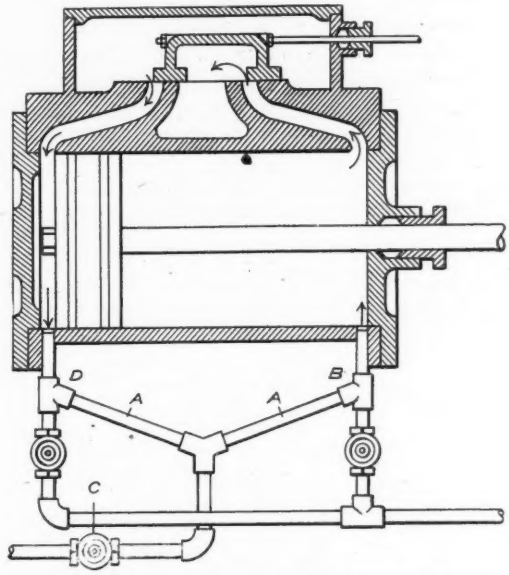
from the engine was still going through the heater. As the feed valves were tightened and the check valve between the heater and the pump was tight, and there was no relief valve in the feed line, the water could not expand, with the result that a high pressure was created in the heater and feed line. This did not prove to be a case where "experience is a dear teacher," but the liability from this cause, of starting the heater to leak or blowing the bonnet off one of the feed valves, was too great for comfort. A relief valve that will relieve is now acting as a watchdog on that feed line.

T. A. R.

Cylinder Drip Connections

Editor Practical Engineer:

I notice in the March number, on page 34, H. B. says an engineer in a plant where he worked did not believe in having his cylinder drips connected up for



SKETCH OF PIPING TO DRAIN CYLINDER

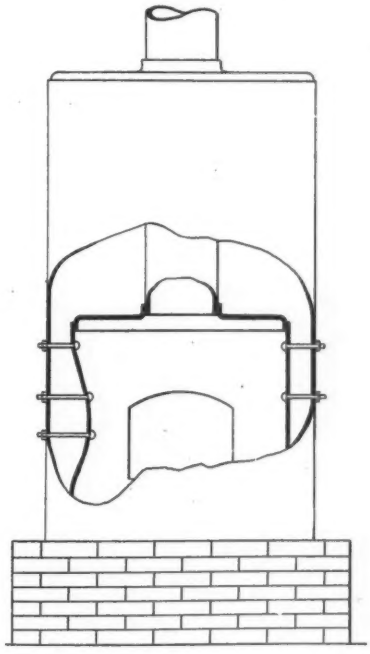
warming the cylinder in the way F. J. D. showed in the December issue. I wish to say, if that engineer ran his engine connected up in the manner H. B. shows, I would like to see some of the indicator cards taken from it. I think his steam consumption would figure out rather high. He might economize over F. J. D.'s plan while his engine was standing still, but I think he would lose more than he would save while the engine is running. It will be seen when the engine is taking steam on one end that the steam will pass down out the cylinder drip, as shown by the arrows, and across the connecting pipes A, A into the other end of the cylinder and out through the exhaust, thus reducing the forward pressure and increasing the back pressure, which would reduce the power of the engine. Instead of having a valve at C, he should have two valves, one at B and one at D.

Detroit, Mich. Norman S. Campbell.

Trouble With Vertical Boiler

Editor Practical Engineer:

I have an upright boiler that is bulged in, as shown in the drawing. My remedy was to drill holes through the outside and inside sheets to correspond and insert stay bolts. The boiler is used for low pressure, scarcely over 50 lb. pressure ever being used. Will some



METHOD OF STAYING BULGED SHEET

reader of the Practical Engineer tell what caused this trouble? Gus. A. Janicke.

Engine Room Troubles

Editor Practical Engineer:

A power plant which was recently erected contained, among other apparatus, a closed feed-water heater. The erecting engineer gave the engine a preliminary trial, exhausting through the heater without using the latter for heating the feedwater, leaving the heater, as he supposed, empty. To his astonishment, after running a few minutes, steam was seen issuing from the heater. The engine was shut down and the heater tubes were examined for collapse, imperfect calking, beading, etc., but everything was found in good order. So the engine was started again, and the same phenomenon occurred. The engineer shut the engine down again and studied over the matter. Going to the heater, he removed one of the plates and reached down to the bottom, where he found a small quantity of water. This was removed, and when the engine was again started no more steam issued from the heater.

Another engine developed a knock or click which defied all efforts of the engineer to discover it. It could not be located, so a machinist was called in,

and after looking wise, he said he would call on Sunday, when the engine was at rest. He came, but his efforts were in vain. Then a foreman of an engine shop was called in, and after watching and examining the engine awhile, he told the engineer to shut down a minute. On examination the babbitt on the crosshead shoe was found loose. The shoe was rebabbitted and the trouble was remedied.

Burlington, Ia. E. G. H.

Must a Man be a College Graduate?

Editor Practical Engineer:

I notice in the March issue that P. E. C. says that a man must be a college graduate to understand the majority of books written on "engineering." He also

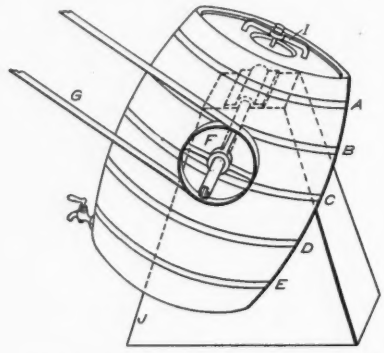


FIG. 1. KEG WITH WOODEN RIBS AS OVERALL WASHER

states that they are of little practical value and that they are full of mathematics and complicated formulas. I don't believe P. E. C. really meant all that his letter seems to imply. I possess quite a few books which are called among the best, and there are a multitude of things in them that I do not understand at present. If I did I would not have bought the books. I would have written some instead. What is the use of buying books to teach us about one of the most important occupations and then expect them to be written like a child's Christmas story book?

I own such books as Kent's, Hawkins', Spangenberg's, Ferenbatch's, Tulley's, etc., and I haven't seen a mathematical problem in them that could not be understood by using a standard arithmetic as a guide. I am afraid too many of us want to pick up a high class book and get information out of it that the writer gave us credit for knowing already.

Some engineers buy books and look them over and strike some problem that they would have thought easy when they were wearing short trousers at school, and just because they have forgotten it they say: "Oh, that's no good, it's too complicated." Dig out that old arithmetic or buy a new one and you will soon recognize it as an old acquaintance.

Formulas are hard to the average man, but they are in every book and every journal on engineering today. Now, if they were not of immense value this would not be. Therefore, I say, it is up to the engineer to master them if he intends to advance by means of other people's knowledge.

If a man who talked French exclusively had something of the utmost importance to tell you after you had learned to talk his language, you would soon manage to acquire French enough to grasp his meaning, if you possibly could. I don't believe there is an engineer today who is worthy of the title who could not in a compartively short time master enough of the fundamental principles of formulas so that he would understand those he runs across in the majority of engineering books published.

I have no doubt that if our friend P. E. C. was to purchase a complicated piece of apparatus to use in his plant he would trace it out till he thoroughly understood its makeup and the principles involved in its construction. Why not then pick the mathematical problems and the complicated formulas to pieces? Trace them out. The pieces taken separately are all more or less familiar and simple. It is this trying to swallow everything whole that is bothering those of us like P. E. C.

Groton, Mass. C. J. W.

Overall Washer and Home-Made Battery

Editor Practical Engineer:

It is with interest I read queries and kinks from engineer readers of your valuable monthly journal. I

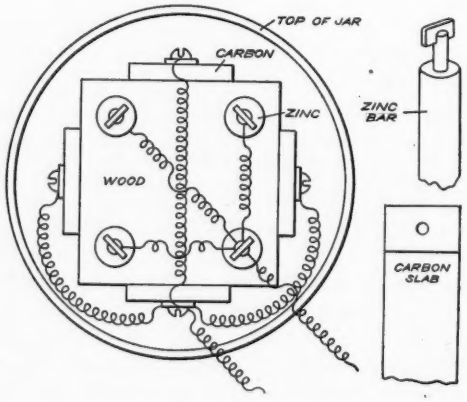


FIG. 2. CONSTRUCTION OF HOME MADE BATTERY

herewith give my idea of an overall washer that requires no steam and no elbow grease. Also in reply to H. H. Y., Trenton, N. J., in March issue, I offer a type of primary cell for his consideration and think it will give him excellent results.

For the washer A, B, C, D, and E are wooden ribs 1 in. square all around inside of the barrel or keg. F is a wooden pulley on shaft which is made of ¾-in. pipe screwed into a floor flange, which is screwed to barrel on both sides. G is belt to transmit power from a slow-running convenient shaft. H is a cock to draw

off the dirty water and I a door in the end of the barrel, with a bridge over it after the style of a manhole cover. J is stand for barrel. Put in 1 cake of soap and half fill barrel with warm water. Put in 2 or more suits of overalls and run barrel or washer about 10 r. p. m.

Articles required to make 1 cell are as follows: 1 glass jar, 5 in. diameter, 7 in. high; 1 wooden block, 2¾ in. square, 1 in. thick; 4 carbon plates, 8 in. high, 2 in. wide, ¼ in. thick, carbons to have 3-16 in. hole in end; 4 wood screws, No. 10, round head, 1 in. long; 4 copper washers, No. 6; 2 pieces copper wire, No. 14, and about 18 in. long; 4 zincs with collars, 6¼ in. long, ⅜ in. diameter. Leclanche zincs answer well.

Bore 4 holes in top of wood, 7-16 in., for zincs, as shown in diagram. Drill a center hole also, in case you might wish to use cell for lighter work, when 1 zinc only would be needed. Now take carbons and screw to side of wood, but be sure to put copper washer under head of screw. Now wire up as shown in diagram and put in jar.

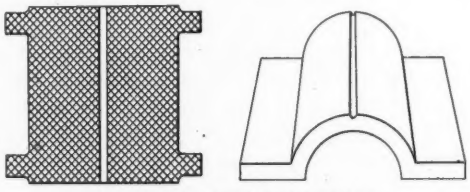
For the solution use ½ lb. of saltpetre, 1 lb. bichromate of potash, 9 pints of rain water; then slowly add, stirring all the time, 1½ pints of commercial sulphuric acid. It becomes warm when mixing and when solution is cold the cell is ready for use. Never put water into acid, always add acid to water. These cells, charged with the above solution, give a very strong current, about 12 amp., and an e. m. f of 1.9 volts.

F. Chester.

Large Corliss Fails to Drive 8 h. p. Motor; Loose Brasses

Editor Practical Engineer:

The power plant of a new factory gave the owners considerable trouble. The engine was a 10x30-in. Corliss, driving a 60 k. w. a. c. generator. It was second



SPREADING METAL OF BRASS

STRIP ON BOX TO PREVENT ROCKING

hand, and on advice of engineer and machinist, who was called in, the valve chambers were rebored and a new bull ring made for the piston. The engine was then in good shape, but trouble still existed.

A motor of 7 or 8 h. p. ran the elevator, but the outfit was incapable of furnishing enough current to run this motor; the voltage would drop and the ammeter would run up. The machinist was again called and indicated the engine; the result showed that when the load was thrown on, there was less than 20 h. p. used, and he suggested that the trouble must be in the wiring.

So an expert came and remained two days, then left without discovering the cause and blaming the engine. He said it was too small, but the engineer held to the opinion that it surely was large enough to run an 8 h. p. motor with some degree of success.

At last a man was sent from the factory. He discovered at once that the connections of the dynamo were wrong. He took it apart and after working on it a couple of days, put it together again. Everything is now O. K.

In the case of the Corliss engine pound, remedied by W. S., page 32, April issue, the inserted pegs are liable to wear down in a short time. If he would solder or "sweat" a thin piece of brass along the side of each half box, it would have more bearing sideways against the crosshead and, consequently, there would be less wear.

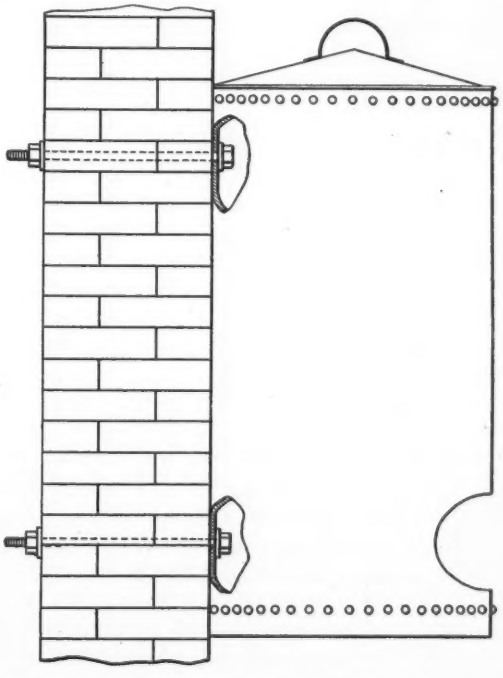
Speaking of loose brasses; they often become loose in the rod, and a good way to remedy them is to take a flat chisel, not very sharp, and cut into the top side of the brass as shown. This spreads the metal and makes a close fit.

E. G. Haddix.

A Practical Joke That Worked Both Ways

Editor Practical Engineer:

Quite recently a brother engineer, hearing that I was going to install a hot water tank for my kitchen,



WATER TANK AS ALUMINUM COVERED WASTE HOLDER

called me up by phone and told me he had a large hot water tank that I could have if I would send a drayman up for it. He said it was practically new. Well, I paid 75 cents to have it brought to the plant

where I am employed, intending to clean and paint the same before taking it home.

Upon its arrival I found it leaked badly around holes where the pipes connected, and one bushing was gone out of top head, making it useless. All this happened on April 1, so the joke was on me.

I knew that my generous friend would soon drop in and see how I liked my tank, so I got to work. I removed the top head by cutting the rivets, and then cut a small hand hole in the side of the tank. I then drilled two holes in the tank to admit bolts, and fastened it to the engine room wall after covering it with aluminum paint. It made a splendid addition to the plant. It holds 50 lb. of clean cotton waste, is mice proof, fireproof and water proof.

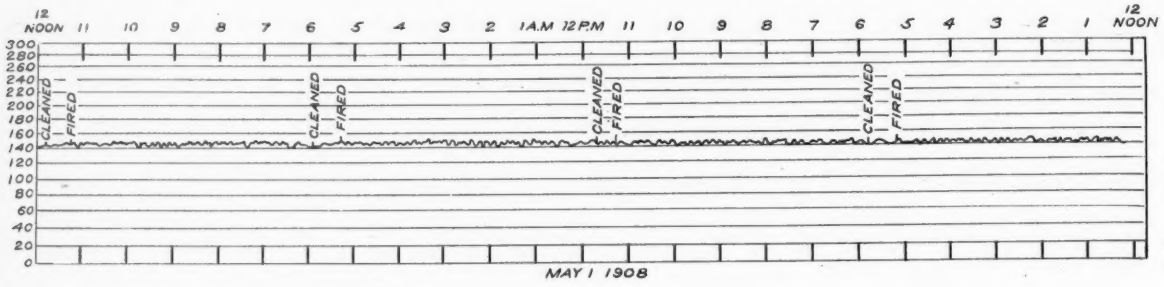
When my friend arrived with two other engineers to give me the laugh, they found the joke was on them, and I have heard since that they have been to several junk men asking for old water tanks.

Joliet, Ill. James Browning.

A Boiler Record to Beat

Editor Practical Engineer:

The accompanying steam gage record, which is a fair average of what is taken every day, was taken in a rolling mill power house. The boilers in use were 3 B. and W., each 250 h. p., and 2 Stirling, each 250 h. p., hand-fired, with run-of-mine coal on flat stationary grates. No damper regulators or feed-water controller were installed and the boilers were using natural draft.



RECORDING GAGE CHART TAKEN AT PLANT

Boiler room crew consists of 1 water tender, 2 firemen and 2 coal wheelers, working 12 hr. shifts. The safety valve pops at 150 lb.

Engine room equipment consists of a 300 h. p. electrical unit, with nearly steady load; 50 h. p. air compressor with steady load, 750 h. p. engine driving rolling mill on which the load changes from no load to 75 per cent overload, and which is stopped and started several times a day, sometimes as often as 10 or 20 min.; an 800 h. p. rolling mill engine, with load varying from nothing to 25 per cent overload, and stopping at frequent intervals. The firemen have no notice of these stops beforehand. There is also one 12 and 12 by 12 in. general service pump running 24 hr. per day. The fires are cleaned at from 5:30 to 6:00 a. m., 11:30 a. m. to 12:00 m., 5:30 to 6:30 p. m., and at midnight, as both mill engines are down at this time from 30 to 40 min., which is time enough to clean the 5 boilers with the coal passers' help.

Average temperature of feed water is 206 deg. F., and the feed pump averages 4700 gal. per hr., which shows that the boilers are carrying a full load and do not pop over 3 or 4 times a day. If any of the readers of the Practical Engineer can beat this record under the same conditions, would be pleased to hear from them. J. C. Hawkins.

Good Advice From an Old Timer

Editor Practical Engineer:

How can I learn to be an engineer? How many times does the old and experienced engineer have that question put to him by some young man either directly or indirectly in touch with him and his plant, and after this same youngster has got as far as an oiler's or water tender's position, the question will be changed to, how can I find out this or that?

In the first place, you must keep sober and pick the best company you can find—morally, mentally and financially. The rest will take care of itself in that direction. Second, keep your eyes and ears open and your mouth shut, and be sure you are right before you go ahead. When you do anything, do it right and faithfully, for a job well done in an engine or boiler room is done a dozen times.

Above all be faithful to your employer, and give him what he pays you for, and remember that the time has gone by when all the engineer has to do is to start and stop his engines, sit and smoke and tell stories and draw his salary. The engineer of today has as much responsibility resting on his shoulders as any man in the world, bar none, and if you would be a success, you must work and study. Trust to no one, but know your plant to the smallest detail.

Now for a few directions to gain a knowledge of the machinery under your care. The best investment a young engineer or "would-be-engineer" can make, is to subscribe to as many engineering magazines as he can find money to do so with, and when they arrive read the question and answer department and the

letters from engineers. The writer secured a first class engineer's license in Massachusetts, and all the book knowledge he had was obtained from the columns of the Practical Engineer and two others. In 18 yr. practice he has never had to stop a plant or an engine for over 10 min., and that only twice. He has never caused an employer to spend $5 to replace broken machinery, and when the bell rang to start up, he was ready to start and keep going till quitting time.

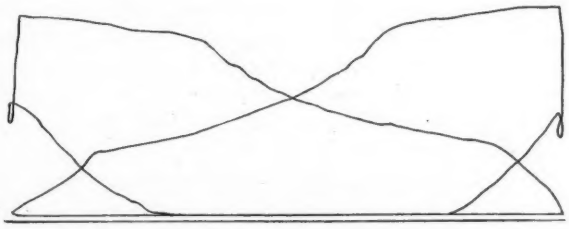
Another good means of getting posted on the different apparatus in use in a steam plant, is to answer the advertisements found in the magazines. There is no method in the reach of the man employed in a steam plant that will yield so big a per cent of profit in a practical knowledge of steam machinery, as can be obtained from the catalogs that are distributed free for the asking by the manufacturers of engines, pumps, heaters and all other steam apparatus. Many of these catalogs contain technical knowledge in a condensed form that would take months of study and dollars in tuition to acquire by the ordinary means. Think this advice over, brothers, try it yourselves and see if it is not worth following. W. E.

Woodstock, N. H.

Cutoff by the D Valve

Editor Practical Engineer:

In the May issue I note an article entitled "Why the D Valve Cannot Cut Off Early." The author



DIAGRAMS FROM AN 8 BY 12 IN. ENGINE WITH D SLIDE VALVE AND CUTOFF AT ABOUT 1/3 STROKE. INITIAL PRESSURE 95 LB., SPRING 50, SPEED 100 R. P. M., VALVE NOT BALANCED.

states that the practical limit for cutoff with this type of valve is about 5/8 stroke, and further shows a diagram illustrating the type of card that would be obtained with a cutoff of about 3/8 stroke. In this connection the drawing herewith from an actual diagram may be of interest.

The cylinder of the engine from which the card was taken is 8 in. diameter by 12 in. stroke and is fitted with an ordinary D slide valve. The cutoff is at approximately 1/3 the stroke. There is some wire drawing of the steam and falling off in pressure, as noted in the article referred to above, but not enough to be a serious matter.

I cannot state positively what causes the drop at the end of compression, but it looks to me very much like leakage, probably by the piston. You will note that the compression line falls below the theoretical and the falling off begins to be quite apparent beyond the point where the compression line crosses the release line. This in itself would indicate a leak. If, as in the usual construction, the valve had a slight lead and opened before the end of the stroke the admission line would pick up the compression line and there would be no apparent drop. In this case, however, the valve does not open until after re-expansion has begun in the clearance. If compression occurred in a perfectly tight cylinder, with no condensation losses, the re-expansion would follow back on the same line as the compression but in case of a leak, a loop will be formed.

These valves set to cut off at from 1/3 to 0.4 stroke have been furnished on many engines and have given excellent results both as regards operation and economy.

There is some difference made between the setting of the eccentric for this case and for the case of later cutoffs. For the early cutoffs it has been found advisable to give a "negative lead" or in other words the valve opening is delayed until after the crank has passed the center. It will be noticed from the diagram that the admission leans in towards the center showing a late admission.

There is no question in my mind but what cutoff as early as 3/8 stroke can be accomplished with an ordinary D valve provided that the speed of the engine is not too high. In the case of engines running at 200 to 250 feet a minute, I know that it is all right and with properly designed ports I believe that it could be used at higher speeds. H. M. Chase.

DIRECT CURRENT AT 1,200 VOLTS

Transmission of current for electric railroads has passed through a number of stages of development, the newest idea being the use of direct current at 1,200 volts. This is applied to a line between Indianapolis and Louisville, the voltage being secured by putting two 600-volt dynamos in series. The car equipment consists of four 75-h. p. motors for 600 volts, two of these being always run in series when used on the 1,200-volt supply line. For the ordinary city service, the four are used in parallel or with two sets of two in series. For the interurban work on the 1,200-volt section, the motors are used two in series and two sets in parallel, or four in series. Control circuits of the apparatus on the car are operated by 600-volt current secured by the use of a dynamotor placed on the car. The car motors used are of box frame type. They are two-pole motors with commutating poles between exciting poles, the windings all being connected in series with one another and with the armature. The function of the commutating poles is to produce a field equal in amount to that set up in the armature winding and of the opposite direction, so that the net field in the motor shall always be that due to the exciting pole windings only.

FARMING FOR POWER

From the prospectus of the Sun Power Co. this will be the easiest kind of farming ever, and the easiest power plant to care for that one can conceive. The rule for this industry seems to be to build a hot bed with a bottom of asphalt. Fill this with water; connect to a steam turbine and condensing plant and wait for results. No coal to shovel, no grates to clean, no ash to take away. The steam from the surface condenser is to go back to the hot bed or sun heater for another round, pumps for all purposes being driven electrically from the main generator, and so merrily on is this mill to go until something wears out or breaks. No care required but to fill the oil reservoirs in the bearing of the pumps and turbo-generator once a month. To shut down the plant put a blanket on the hot bed. To start up, take off the blanket.

Some of the statements of the promoters of "Power Farming" are rather startling, but not impossible, such as that 240 deg. F. has been reached by the water in this hot bed design of boiler, and that such a boiler with 160,000 sq. ft. of top surface will give 1,000 h. p.

Some experimenting has been carried on by the inventor of this system, and some of the ideas are ingenious as for instance floating paraffine on the water surface to lessen radiation loss, and storage of heat by means of a large tank of water, although the latter expedient is an old one. Other of the propositions do not look so plausible; such as using steam in the turbine at 202 deg. F. or about 3 lb. vacuum initial pressure; circulation of water throughout the system by gravity at no heat or energy cost; and the production of liquid air at a cost of $1 a ton, which in another paragraph is assumed to be 1/10 the present cost. We do not remember to have seen market quotations of liquid air at $10 a ton or near that figure.

The inventor is supposed to have "sailed for Europe" some time since to "exploit" sun power in the Eastern Hemisphere with the backing of "some of the wealthiest men in the world." This is fortunate for him, for it seems that he is likely to need a long pocket-book before he realizes profit on this scheme to corner the Sun's energy. It is unfortunate when a man with some good mechanical ideas gets to chasing a rainbow. His very knowledge and ideas are likely to be the means of wildcat financing in inventions as crazy as any "planted" mine that ever caught a greenhorn.

In connection with the national congress to consider the preservation of our natural resources, President Roosevelt said: "We are at the turning of the ways; we may pass on along the line we have been following, exhaust our natural resources, continue to let the future take care of itself, or we may do the simple obvious common-sense thing in the interest of the nation, just as each of us does in his own personal affairs."

REFRIGERATING KINKS FOR THE ENGINEER

In a recent paper before the Western Ice Manufacturers' Association, William Nottberg presented some kinks which should prove of interest to refrigerating engineers.

"The latest thing in our business is the atmospheric flask condenser and same is built right here in Kansas City. Just figure in dollars and cents the cost of reboiling in your plant. In this condenser you get rid of all the air and obnoxious gases in your condensed steam without reboiling and also use less than 50 per cent of the cooling water to condense the same amount of steam now used on the old style pipe condenser.

"Not an altogether new kink is the ammonia purifier. No plant can afford to be without one. A prominent ice manufacturer had the misfortune the other day to get brine into the ammonia system. We all know what that means. He called me over long distance phone something like this: 'Bill, have you an ammonia distiller I could borrow? I am in a fix. Send it by express, no matter what it costs,' etc. Less than 6 hr. later it was on an express train; rather expensive, but when I told my friend to get one he thought 'What for?' He can tell you now. I bought one to replace the one I sent to my friend at once, or rather he ordered it. Now I use this distiller every day, no matter if there is any need of it or not. It takes all of the oil out of the system.

"Another new kink is the necessity of a pump-out on bottom of each ammonia condenser coil. I found by having same connected to main suction line, you can pump out of a condenser section in less than one-third the time it takes to pump out from the top, the way they come from the factory. It would be a good idea to have a complete connection, permanently in place. The cost will be saved in a short time. It also comes in handy for pumping empty one coil at a time rather than by purging on top to get rid of air. This pumping-out connection can also be connected with the ammonia distiller. This prevents liquid from passing into the compressor and the oil and other impurities are at once extracted.

"Another new kink I want to impress on all refrigerating men is the necessity of having spare fittings. Last summer one of my fellow engineers in a 250-ton plant had a 4-in. high pressure elbow on the discharge line from the compressor to the condenser burst, losing almost all of the ammonia. About 4:30 on a nice Sunday morning my telephone rings. 'Is that you, Bill?'—then—'have you an Arctic 4-in. ell?' I said, 'Sure I have; not only the ell but its companion union flanges.' Just think, if I had not had that ell our friend would have been in a nice fix. To get one from Canton by express would have been the only way, which at best would have taken 24 hr. I believe the time has come when the ice manufacturer can and should demand that all ice machine builders should have a uniform standard all the way through.

ENGINEERING COURSES, NORTHWESTERN UNIVERSITY

NORTHWESTERN UNIVERSITY, at Evanston, Ill., which has for many years stood for scholarly education in the liberal arts and in several special branches, has recently, by a bequest for that purpose, been placed in position to offer courses in engineering, and the first building for the use of these courses is now under construction. In planning for the work which shall be offered by this department, Dr. A. W. Harris and the board of trustees have felt that there was not occasion to duplicate engineering courses already offered in the colleges in and about Chicago, but that something different from an ordinary engineering course might better be devised. With this end in view, it was planned to make the course 5 yr. with a possible addition of a sixth year to be recommended to all who can avail themselves of it.

The foundation of the course will be a liberal education and preparation for the professional work, putting the engineering department on the same basis as the law or medical schools, although having the courses in the culture studies somewhat differently arranged so that they may prepare specially for the later engineering work. Dr. Harris proposes that the first 3 yr. shall be taken up with the languages, sciences, mathematics, history and economics, with a beginning probably in the third year of the engineering studies, the last 2 yr. to be devoted almost entirely to special engineering branches. The fundamental thought in this arrangement is to train the man first of all in the scientific principles of engineering and the fundamentals of the sciences which are closely allied to the engineer's work, so that a graduate from the engineering department of Northwestern, although he may have specialized in his last year or two, will be well fitted to take up any branch of engineering work and will have to add to his preparation only the study of such special features as enter strongly into one or another division of engineering.

Division between different branches of engineering is so indefinite and the probability that an engineer at the present day will have to practice two or three branches of the profession in the course of his work is so great that a broad general training is deemed of more value than a strictly specialized course. With this end in view, the organization of the engineering faculty will probably be somewhat different from that usually planned. A department of engineering will be established having at its head a director who will have supervision over the entire group of engineering courses. Each different branch will have its own professor who will deal with the special subjects of his branch, but the preparatory mathematics and science work will be in common for all courses and the advanced training, to a considerable extent, will be given in common to all students, the specializing being handled very largely by electives which can be combined according to the desires of the students with the advice of the director of the engineering department.

The same degree will be granted to all graduates from the department and an advanced degree of mechanical, civil, electrical or other engineer will be granted at the end of the post graduate year of work, which will be devoted to strictly specialized study. The officers of the university have in mind a course which will make, first of all, a scholarly man, and, second, one who is well prepared to perfect himself in any branch of engineering work. The plans as at present outlined contemplate the offering of the first 3 yr. of the work of the engineering department with the opening of the school year in the fall of 1908, the other 2 yr. of the undergraduate course being offered for the first time in 1909 and 1910 respectively. It is not the intention to attempt at once to create a large engineering school, but rather to build slowly and surely, so that no steps will need to be retraced.

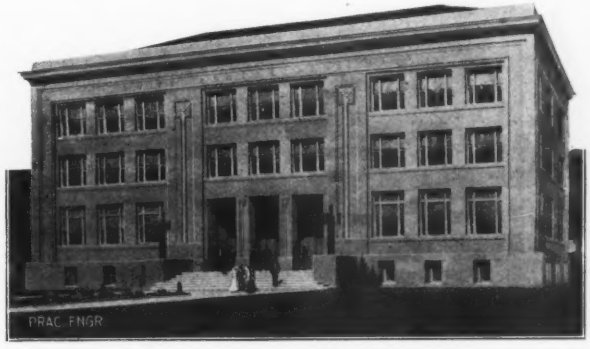


FIG. I. THE NEW ENGINEERING BUILDING AT EVANSTON

In making plans for the new Engineering Building, George W. Maher, of Chicago, the architect to whom the work has been delegated, has developed a general campus plan for future enlargements of the University which has many notable features. The property lies along the shore of Lake Michigan with a shore line of about 4,000 ft. and a width of 700 ft. between the shore and Sheridan Drive. This shape of plot and the low horizontal line of the lake suggest the use of horizontal lines in the building architecture and a straight central avenue or parkway on which the future buildings shall face. Buildings so far erected have been at the south end of the campus and in somewhat irregular arrangement, but fortunately two of them are so placed as to give an axis in a general northeast and southwest direction intersecting the axis of the main parkway but near enough

at one end to form a practical continuation of the general scheme, although at a slight angle. The other bulidings will be included in the landscape arrangement by the laying out of walks and drives, but cannot be made an integral part of the main plan.

About midway of the campus the administration building, which is the center of the entire scheme, is to be placed, having a driveway leading from Sheridan Road to it, this entrance-way flanked on either side by a building for university purposes. Arranged about the administration are to be four halls for classroom and laboratory purposes. A little way to the south is the Engineering building, facing on the main parkway and between it and the lake front. It is more closely related to the Lunt Library building than to any other feature of the campus plan, and its architecture is in horizontal lines embodying original treatment of what Mr. Maher terms "American ideals of college architecture," although based upon the Greek thought.

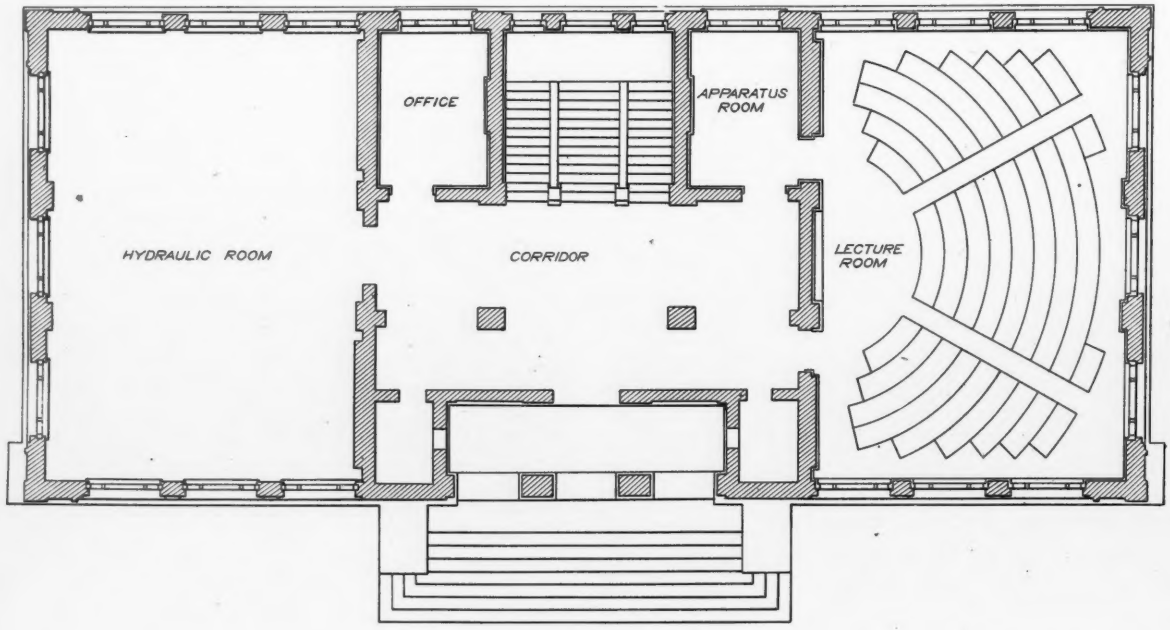


FIG. 2. PLAN OF FIRST FLOOR

To the north of the administration group of buildings is to be an athletic field, and beyond this a gymnasium and a group of 3 dormitories, each containing 6 buildings.

Mr. Maher's thought in design for the Engineering building has been to embody the Greek spirit, to hold to severe lines which will express the direct thinking and ideals of an educational institution and to avoid useless carvings and ornamentation, depending for beauty upon correct lines and proportions. The building is to have 4 stories.

TEN SQUARE FEET OF HEATING SURFACE is usually taken per horse power for water tube boilers.

RULES FOR POWER TO DRIVE MACHINE TOOLS

FROM tests and observations in the works of the Westinghouse Electric & Mfg. Co., J. A. Barr has compiled rules for equipping machine tools with individual motor drive as follows: In all cases, unless otherwise mentioned, machines are supposed to use water hardened steel tools and to be run at a cutting speed of 20 ft. a minute.

Lathes with one cutting tool; h. p. = (0.15 x swing in inches) 1. For heavy lathes used on rough forgings; h. p. = (0.234 x swing in inches) 2.

Boring mills, using one cutter on heavy work; h. p. = (0.25 x swing in inches) 4.

Milling machines, for normal work; h. p. = 0.3 x distance between housings in inches.

Drill presses, for normal work; h. p. = 0.06 x swing in inches. For heavy radial work; h. p. = 0.1 x swing in inches.

Slotters, normal work at 15 to 26 ft. a minute; stroke 10 in., h. p. 5; stroke 18 in., h. p. 7; stroke 30 in., h. p. 10.

Shapers at 15 to 20 ft. a minute; stroke 16 in., h. p. 3; stroke 18 in., h. p. 3.5; stroke 24 in., h. p. 5; stroke 36 in., h. p. 6.5.

Planers, for normal use, at 15 to 20 ft. a minute, h. p. = 3 x the width between housing in feet. For heavy work; h. p. = 4.92 x width between housings in feet.

Normal planer work is meant when the length of the bed in feet is approximately 0.2 the width between housings in inches, and the values above are for planers having a cutting speed 1/3 the return speed and not more than 2 tools in operation.

CONVENTION OF ILLINOIS STATE ASSOCIATION N. A. S. E.

Held at Chicago, May 16 and 17, 1908

THIS meeting was of special importance to engineers in the state of Illinois because at it was crystallized the movement to endeavor to secure a state license law. A large and representative body of delegates was present from the different associations constituting the state body and all of them were enthusiastic in taking up this work. While there are some with dissenting opinions as to the value of license law, in those states where such laws are in force, the great majority, in fact almost all engineers are of the opinion that the conditions of the engineer are greatly benefited by the enactment of such laws, that the safety of the community is guarded and that the interests of employers are conserved. The motion to appoint a committee to take up the subject of state license law came as the climax to a day well spent in consideration of the interests of engineers in general and the members of the National Association in particular.

DELEGATES AND GUESTS AT THE ILLINOIS STATE CONVENTION N. A. S. E., CHICAGO, MAY 17

Morning Session

Fred W. Raven, national secretary and past state president, called the convention to order, welcomed to the city the delegates from other associations and introduced Emil C. Wetten, of the corporation counsel's office, who spoke in place of the mayor. His address of welcome was responded to by State President Steele, after which addresses were delivered on behalf of the Chicago local committee by Messrs. Wm. A. Gibson, speaking for the Chicago Association of Commerce, Prof. P. B. Woodworth of Lewis Institute, and Western Starr of the Chicago Civil Service League. Responses on behalf of the association to these speakers were made by W. L. Jackson, state deputy for Illinois, John W. Lane, past national president, and James Henry Harris of Illinois No. 1.

Mr. Gibson called special attention to the growing importance of Chicago as a commercial center and to the interest which all citizens of the state of Illinois should take in this growth and in the deep water way which will greatly promote that growth. The welfare of the chief city of the state is certain to contribute greatly to the welfare of the state as a whole, and from figures recently secured the estimate is now made that the city will have in the year 1974 ten million inhabitants, which will make it the largest commercial center in the country.

All speakers complimented particularly the association on its principles and the work that it was doing and the benefit that it must be to members.

After appointment of committees on credentials and auditing, the morning session was adjourned to reconvene at 2 o'clock.

Afternoon Session

Reports of committees were the first thing in order and then reports of officers. A comfortable amount was found to be in the treasury and the secretary reported that there was some growth of the association in the state but that no new organizations had come into the state body, although several were thinking of doing so. Several speakers gave reports on the conditions of engineers in the state. Mr. Hill, of Moline, reported that 90 per cent of the engineers in that city

were in the association, but that of the 6,000 engineers in the state of Illinois only 25 per cent were now enrolled in locals and that only 50 per cent of the locals in the state were associated in the state body. This is on account of two things: First, many engineers throughout the state are so located that they cannot well join associations. Second, no great object has ever been taken up by the state association for its efforts.

Mr. Randles, of Peoria, spoke in place of J. B. Kearney, who was unavoidably away, and said that in the city of Peroria about 185 of the 250 engineers were members of engineering societies, 60 of these belonging to the N. A. S. E. The object of this association was education rather than recreation and that this should be the object of all meetings. While recreation is an important part of the work, it should bc made secondary to the educational feature.

W. W. Brooker, of Joliet, gave a detailed report on the conditions as to pay and working hours in that city. Other speakers from different parts of the state gave briefly some idea of the conditions, these reports all being preliminary to the question of the movement for a state license law. Those who spoke in discussion of the motion to appoint a committee of five members to take up the subject of state license law were Messrs. Reist, of Illinois No. 1, Brooker of Joliet, ven of Illinois No. 1, Johnson of Illinois No. 28, Raymond, Lyons and Randles of Peoria.

In the course of the discussion, points were brought out that while the present law in Illinois permits cities to pass ordinances for license of engineers, only 2 cities at the present time avail themselves of this privilege. That the city ordinance is not effective in small towns or for big plants outside of the city limits, hence does not accomplish the real purpose of such legislation. That if they are to be passed, all engineers must be convinced of the benefit and need of such laws, and not only engineers but employers and engineering societies must be shown the benefits of such laws. There is no question but what condition of engineers has been improved, the number of accidents lessened and the economy of plants increased by such laws. Engineers must become better engineers in order to pass the examinations, and the standard of engineering is raised by putting the safeguarding of plants under the control of state officials.

The question of graded license was brought up and opinions were expressed both for and against such grading. The general opinion was that grading of some sort was desirable. The motion was finally carried in the form that a committee of 5 should be appointed by the incoming president to take up this subject and that it should be instructed to work for a graded license law. Also the motion was carried that the proceedings of the meeting be published in pamphlet form and sent to each of the other state associations and to each of the subordinate associations in Illinois.

Following this motion, Chairman Alfred Johnson, of the board of trustees, called attention of the members to the growth of the National Engineer and to the benefit it gives to the members of the association. J. G. Beckerleg was called upon and recommended that if license legislation were to be taken up, the attitude of legislators in regard to the matter be ascertained and the benefits of the law be fully explained to them so that they would be in favor of its provisions when the time came for action.

Arthur L. Rice, speaking on the subject of license laws in general, explained the provisions of the Massachusetts and Ohio laws in regard to grading of engineers, the former being graded according to horsepower of the plant which they were supposed to be capable of handling, and the grading being accomplished by examinations of varied difficulty, while in Ohio the grading is done simply by the percentage passed in examination, all engineers being given examinations of equal difficulty.

Messrs. McClellan, of the firm of Jenkins Brothers, and Knobel of Crandall Packing Co., spoke in regard to the effort of the Supply Men to form an association for the handling of the entertainment features of the central states conventions and the failure of this movement to succeed, also the possibility of forming new associations in the state of Illinois.

John W. Lane, past national president, then spoke in regard to the difficulty of grading engineers on a license law. The percentage on the examination does not tell a man's ability to handle a plant, and in deciding what horsepower a man can handle the setting of limits is a difficult proposition and one which no one is really capable of doing wisely. Mr. Lane was in favor of a law which does not provide for the grading of engineers and in which the examination is based on the plant to be run, a license for a given plant giving practically the right to run any plant of similar size and equipment, but a change to a new, and more important plant calling for re-examination.

This closed the speaking of the day and the election of officers was then taken up, resulting as follows:

President, W. W. Brooker, Joliet; Vice-President, J. L. Randles, of Peoria; Secretary-Treasurer, W. E. Hill, of Moline. The officers were then installed and the convention adjourned to meet subject to the call of the president.

In the evening the members were entertained at a theater party at the Majestic Theater tendered to the delegates by the Chicago associations, and on the 17th the delegates attended the service by Dr. Gunsaulus at the Auditorium. In the afternoon provisions were made for those who wished to go to the ball game between the Cubs and Brooklyns, as guests of the Chicago Association of Commerce.

ONE SQUARE FOOT OF HEATING SURFACE ordinarily evaporates 3 pounds of water per hour.

CORRECTING REVERSED POLARITY OF GENERATORS

IN DIRECT-CURRENT machinery the direction of rotation is sometimes a matter of doubt or considerable trouble. Most any generator or motor is intended to run in a certain direction and is said to revolve right-handed or left-handed, depending whether or not the armature revolves like the hands of a clock or in the opposite direction, when looking at the pulley or driving end. Most generators are designed right-handed, but are made left-handed if specially ordered. In their operation generators of small and even large size frequently have their polarity reversed, and when this happens, it is usually desired to correct the trouble with the least possible delay and restore the machine to its normal method of operation.

There are a number of ways of doing this, and in the case of a small or moderate sized machine, say under 100 kw., it is an easy matter to give the machine its correct polarity. The usual method is to raise all the brushes from the commutator and carefully insulate them from it. In the majority of cases the generator will be either shunt or compound wound, and by closing the switch to the busbars, this will allow current to flow through the shunt field winding of the reversed machine in the normal direction. When the current from an outside source has run through the shunt field for a few minutes, the switch to the busbars may be opened, the brushes lowered on the commutator and the machine, which has now the right polarity, will readily start and build up from the residual magnetism in the field and run in the right direction.

This method is all very well for small machines, but should never be used on a large dynamo, that is on a generator rated at 100 kw. or over. In machines of this size there are usually several sets of brush holders and several brushes to each set, so that insulating them all from the commutator would be not only tedious but a rather dangerous proposition, as it would be very easy to accidentally cause a short circuit through the armature. This would undoubtedly put the machine out of commission and would be much worse than having a generator of reversed polarity.

In shunt wound generators especially, a method sometimes used is to reverse the shunt field leads, as indicated in Fig. 1, start up the generator, and as soon as the voltmeter shows any voltage it will indicate that the machine has been restored to its normal condition. The shunt leads can be changed back and the machine will usually pick up without any further trouble. Sometimes, however, the machine will refuse to build up its voltage at all, this being caused by the armature having too little magnetizing effect on the field magnet and for this reason failing to carry the magnet over the neutral point of magnetization. It is, therefore, not altogether advisable to use this method, its only advantage being simplicity and the possible saving of considerable time.

For shunt wound generators a sure method is to disconnect the shunt field leads entirely and connect them to some external source of current. This current, of course, must be sent through the shunt coil in the right direction and, of course, should never be at a higher voltage than that for which the machine was designed. A higher voltage can be readily cut down by inserting a number of lamps or other resistance in the circuit, so that no trouble should result on this account. A point to be observed before this method is altogether safe, is to provide a discharge resistance in connection with the switch which will open and close the shunt field circuit. This is made necessary by the e. m. f. induced in the field magnet wind-

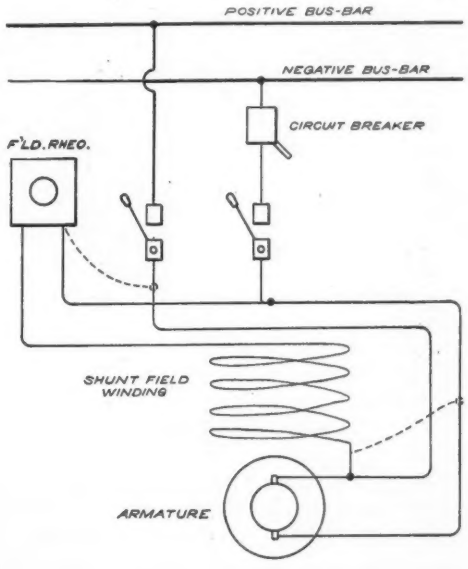


FIG. I. CORRECTING POLARITY OF SHUNT WOUND DYNAMO

ing, which, when the circuit is opened or closed in large machines, is almost sure to jump across the shortest gap between the conductors unless a non-inductive resistance, such as a bank of lamps, is connected across the leads between the field magnet coils and the point in which the circuit is to be opened or closed.

When these precautions have been observed the external current may be turned on, and if it is up to full voltage, a few seconds will be sufficient to reverse the polarity. Before shutting off the current, however, it is well to make sure by means of a voltmeter that the polarity has been corrected. The shunt leads can now be returned to their proper terminals and the machine cannot fail to pick up in the right direction. This method takes considerable time and its

advantage over the method given previously is that it cannot fail to correct the polarity.

The method just given is usually recommended as the best for application to shunt wound generators, but is not satisfactory for compound generators, of which there are a great number in use. For the compound machines a much simpler method is used. It is not necessary to disconnect or change a wire, and if instructions are properly followed, there is no danger to the machine or operator, and the polarity can be corrected in very short order.

Figure 2 shows the usual method of connecting 2 compound wound generators to a common set of busbars, and by reference to this drawing it will be noted that the current from any machine connected to the equalizing bus by the equalizing switch will divide and a part of it will go to the series winding of any other machine connected to this bus, the amount depending upon the resistance of the different sets of coils.

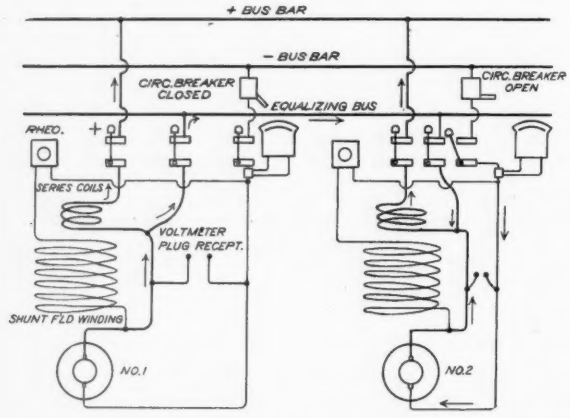


FIG. 2. SIMPLE METHOD OF CORRECTING POLARITY IN COMPOUND GENERATOR

In the present illustration suppose the machine at the left is running properly and the machine at the right has had its polarity reversed. With the machine of reversed polarity brought to a standstill, the first thing to do is to make sure that the circuit breaker and negative switch are open, and for that matter any other connections that might interefere with the operation. Then close the positive and equalizer switches, which will allow current from the machine at the left to pass through the series winding of No. 2 in the right direction and properly magnetize the magnet cores. It is now possible to start up the machine, which will invariably be of the right polarity.

A point to be observed in this method is that the reversed machine must be at rest, otherwise the current from the equalizer connection may not be sufficient to overcome the reversed magnetism due to the current flowing in the opposite direction in the shunt coil. In this case the series coil would remain reversed and in bucking the shunt coil would give an abnormally low voltage.

At some time or other it may happen that all of the machines have had their polarity reversed at the same time. In this case it would be necessary to extend the shunt field leads of 1 machine to the armature terminals of another, and it would only be a case of passing the current in the right direction through the shunt field. With 1 machine corrected it is an easy matter to restore the others to normal condition by the method given previously. If the machines should happen to be of the shunt wound type it would be necessary to extend the shunt field terminals of each machine to the source of current and correct each in its turn.

With these methods in mind, an engineer can readily correct any reversal of polarity, and in critical moments it will be of great value to have them at his finger tips so that the polarity may be corrected in the least possible time.

CURING A TROUBLESOME POUND IN PUMP

By C. W. Dunlap

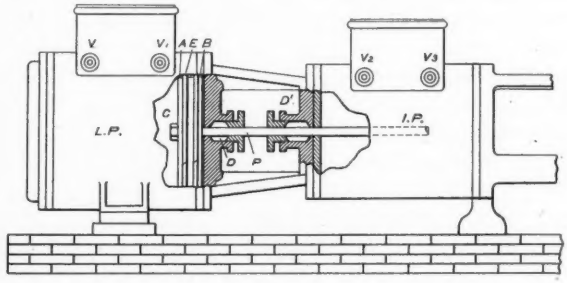
A SHORT time ago the writer was called upon to make an examination of a pumping engine. Several times the engineer in charge of the plant said that there was a bad pound in one of the triple tandem compound, duplex pumps, and that he had looked the pump over thoroughly, yet he couldn't find it. I was soon at the scene of the trouble and found that it was pretty much as he had said; the old machine did have a bad pound.

As is customary with me, I began to question the engineer as carefully regarding the engine as a physician would a patient for symptoms of disease. My first question was: "Are you positive that the plunger is bolted tight to the hub of the rod?" To this question he replied that only the day previous he had removed the plunger and tightened the nuts that hold the hub and then thoroughly tightened the nuts holding the plunger to the hub. I asked him if he was sure about the pistons being tight. To this he replied that he had examined each one of the three on the side where the pound existed and found them very tight. Then without further questioning I suggested that he remove the 2 keys in the crosshead between the intermediate and the high-pressure cylinders. This he did, and I found them both to be a perfect fit, as was each piston rod's taper fit to the crosshead.

Surely there must be something loose somewhere; could it be that the pump was getting air on either end of its supply? This we examined carefully and found the pump taking water from a reservoir a few feet distant, at 4½ lb. head, with all the joints in the supply pipe flanged and gasketed together, through which there was no perceptible leak. The inboard suction chamber containing the stuffing box and gland over the plunger rod were examined and found properly packed and not leaking any. Then the water cylinder head was removed and the gland over the plunger (inside packed type) was examined and found

to be in place and in good condition. By admitting water to the inboard suction chamber until it attained sufficient pressure to force the plunger on its outboard motion, we found the plunger to be packed amply tight to allow no leak whatever.

We had looked over and questioned nearly every feature that I could think of, when it occurred to me to ask the engineer how long the plant had been running. When he said over 10 yr. with little or no repairs it occurred to me that probably the pistons were considerably worn in the low-pressure cylinders and that they were the source of the thumping noise. So before removing a cylinder head, and while the pump



PISTON WORN TO CONSIDERABLY LESS DIAMETER THAN CYLINDER BORE

was still in service, I adjusted the cushion valve V_1, as is shown in the accompanying sketch. By closing it the piston rod at P could be seen to jump slightly at each contact stroke of the piston on the outboard stroke, or where the piston is shown in the sketch. I noticed another little feature, that instantly after the thumping took place the vacuum would drop slightly and that it was impossible to maintain over 18 in. at the best.

The jumping piston rod easily proved where the trouble was. The piston had worn and was much smaller than the cylinder, as is shown at A (exaggerated somewhat). The cylinder bore is shown at B with the rings at E. What could I do to overcome this defect? They didn't want to make any repairs for they contemplated installing a larger unit soon, and any repairs to the old pump would only be a loss. So after examining the two stuffing boxes, D and D_1, and finding but 3 rings of a fibrous packing in each, I suggested that they be both filled so that the gland would just barely enter the stuffing box. This was done and the pump started. The cushion valve, V_1, was left shut and the stroke of the piston regulated by the cushion valve V_3 on the intermediate cylinder.

After the pump was in commission a short time, and the glands D and D_1 taken up some there was a marked improvement in the vacuum. The gage showing 22 to 23 in., I suggested that the other side of the pump be packed in a like manner, and the result was 27½ in. of vacuum. The pump, now running at a speed of 30 to 32 strokes per minute, does not cause any pound whatever, and gives good service.

FIRE BOX LINING

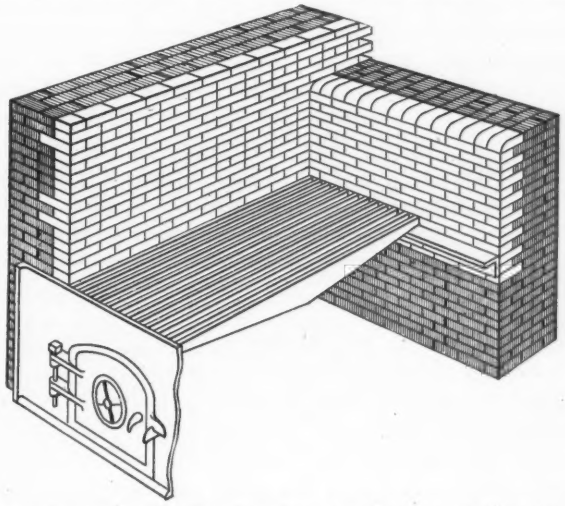
By Thomas Orr

AMONG the many things that an engineer has to keep up in his plant, one of the less frequent, but nevertheless important things which require attention is the relining of the fire box in the boilers. It is customary in most plants to have a brick mason called in to do the work, but in some plants where the engineer is the man-of-allwork, he undertakes the job himself. In brick laying, as in every trade, there is always someone who finds an improved way of doing a job, so I will endeavor to describe a method of lining a fire box which is an improvement.

Starting from the grate 5 course of brick (called stretchers) are laid lengthwise, then a course of brick endways, with half of the bricks projecting into the back wall. These bricks are called headers. Then a course of stretchers are laid on top of the headers, another course of headers are tied into the backing as before and then as usual 5 courses of stretchers and 1 of headers alternately.

The practical utlity of the second row of headers being placed so near to the first, lies in the fact that the first row of headers come so close to the fire that they are generally the first to be burned out, which in case of the old style or common way of setting would leave no support nearer than 5 courses above. It will be readily seen that by having the extra row of headers that when the bottom courses of brick are burned out, it will only be necessary to remove the brick up to the second row of headers.

In finishing off the bridge wall, it has been the custom to have the top finished square, but now all up-to-date boiler setters are finishing off at the top with



METHOD OF RELINING FIRE BOX AND "BULL NOSE" BRICK TO FINISH OFF BRIDGE WALL

what is called "bull nose" brick. This is a brick with one end square and the other round. These brick give the wall a neat appearance and will not allow dirt and soot to accumulate so quickly on top of the wall.

QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

Power of Hoisting Engine

The horse power of a hoisting engine is rated or determined according to the size of cylinders, speed and size of winding drums. Most hoisting engines of any medium or large size are of double cylinder and generally can be crowded for extra lifts by speeding them up, as they have no governor on, but are regulated by throttle. The capacity of such engines is estimated when using a single line on the drum; when using 1 or more blocks as in the case which J. W. S. has on hand, the lifting capacity is increased at the expense of speed.

In his case he would require an engine which would lift 8,000 lb. with single line winding on the drum. This would require an engine of about 30 h. p. or one with 2 cylinders each 8.25 in. diameter and 10 in. stroke. The size of the winding drum would be about 14 in. This engine with a lifting capacity of 8000 lb. on single line would, when connected with a single and double block, have 3 times that lifting power or 24,000 lb., which would be the 12 tons which J. W. S. asks for. Geo. G. McVicker.

Open and Crossed Eccentric Rods

J. C.—Perhaps the enclosed explanation and diagram from Reed's Engineers' Hand Book may be of assistance to J. C. in the Questions and Answers columns of the May issue.

In the accompanying figure is shown graphically the method of obtaining the distance the slide valve has moved. I and J are the centers of the forward and reverse eccentrics, and the full lines show the position of the eccentric rods when the crank is on its left center, and the link block is in mid position. If the engine crank be now turned round from left center to right center, the centers of eccentric sheaves will be I′ and J′, and the eccentric rods will be as shown by the dotted lines. It will be seen from this that when the crank is on the left center the eccentric rods are crossed; when in the opposite position the rods are open. The distance H will be found to be exactly equal to the distance between the lines I J and I′ J′ but the length of the plain eccentric rod is precisely the same length as that of the dotted one, then what is the distance G? If one leg of a compass be put on J, and the other leg at the angle formed by the link and the eccentric rod, and then an arc of a circle drawn so as to show where the rod would be if open now instead of afterwards, we will find that the distance F, which shows the lift of the link thus occasioned, is exactly equal to distance G, thus showing what we wish to show, viz.: that when the link is in mid position, and the crank is turned from left to right, the travel of the valve is $2\times(\text{lap}+\text{lead})\pm$ lift of link. The upper or + sign is to be used if the rods are crossed when crank is at the left, and the lower or — sign, if the rods are open, crank on left center.

"The non-observance of the crossing of the rods often causes the engine to work with a heavy thump, especially at the bottom; the reason of it is, that if the rods are crossed when the crank is on the left center, and the link be run over from forward to reverse gear, the valve will be seen to come to the right during the movement of the first half of the link, and go back

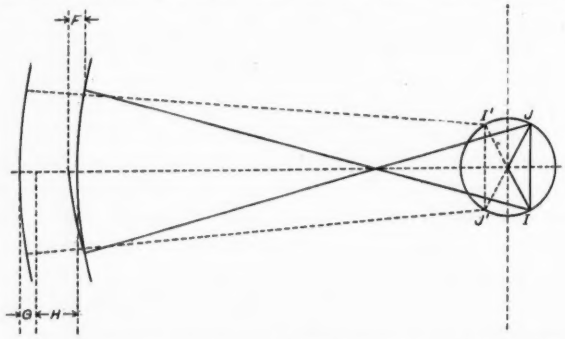


DIAGRAM RELATING TO OPEN AND CROSSED ECCENTRIC RODS

again whilst the last part is passing the block. The reverse of this is the case, namely: that if the rods are open, crank on left center and the link is run over, the valve goes to the left at first and then comes to the right. Now, this makes a great difference when working expansively by the links; in the first case by bringing the valve to the right crank at left we increase the leads left and right, in consequence of the end of the spindle not being directly in line with the end of the eccentric rod. Now, had the rods been open when the crank was on the left center as we linked up, the valve would have moved left a little, and so destroyed a portion of the lead, and the same holds good when the crank comes to the right center. The rods having now become crossed, have drawn over the link, and as the link block is not in a direct line with the end of the eccentric rod, a portion of this right hand move is felt by the valve, and it loses some of its lead on the right."

Setting a Valve With Link Motion

To set the valve with a link motion; first, run the link over to the go-ahead position, and set the

valve for equal lead at head and crank ends just the same as you would if there were no link at all, and only the one eccentric, as with a simple slide valve engine. If necessary, lengthen or shorten the eccentric rod or valve stem (whichever is the more convenient) in order to obtain equal lead. If unequal lead is desired, as in the case of a vertical engine, set the valve accordingly on the stem.

With the crank on dead center, shift the eccentric in the required direction until the lead is as desired for that particular end. Place crank on the other center and see what lead you have. If correct, secure the eccentric. If not correct, the valve stem or eccentric rod must be lengthened or shortened, according to lead requirements, and the eccentric again set to give the lead desired.

Now run the link over to the backing motion and try the valve for lead, head and crank ends, just the same as for the go-ahead motion. If there is any altering to be done with the movement of the valve in the backing motion such alterations must be made by lengthening or shortening the eccentric rod of the backing motion, without disturbing the valve or valve stem which have been set for the go-ahead motion. Lengthening or shortening the backing eccentric rod to get the desired lead of valve in the backing motion will not at all disturb the valve movements in the go-ahead motion. The backing eccentric will be set like the other, unless the operator desires a different lead of valve for that motion of the engine.

Charles J. Mason.

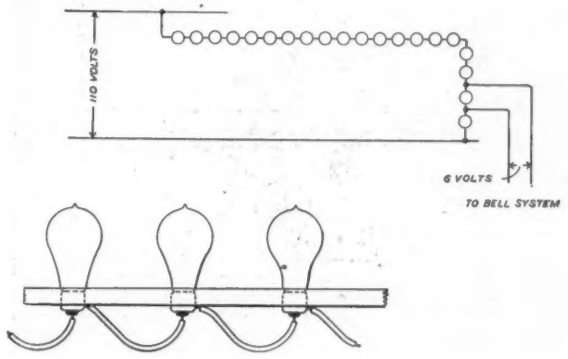
Bell Connections on Generator Circuit

T. A. B.—I wish to know whether or not I can safely run a small system of bells, connected to a generator. We have two machines, one a 110 v., used for lighting, and the other a 550 v. machine, used for power, both being direct-current machines of 25 and 35 k. w. respective capacities. Can I use the current from either of these machines, with some kind of resistance, fuses, etc., in the bell circuits in place of batteries? If so, which voltage can best be reduced to the proper point to safely operate the bells, and by what method can it be done? It is a small 4-point annunciator system, with a return call line from office to boiler room; the others are overflow alarms from cold water tank, hot well, etc. They are only in use when the plant is in operation during the day, so that if it is possible, we can use the current from the generators in place of batteries. The plant is a large sash and door factory, and while there is some dust, there is not a great deal of it, and that is what I was afraid of.

A.—It is entirely possible to run your system of bells from the 110-v. circuit and it will be entirely economical to do so, aside from the cost of getting in resistance to keep down the current. The first cost of installation will be rather high, but after that there should be no expense. Connect between the 110-v. leads a number of lamps in series. This can be done by soldering a piece of wire from the screw of one lamp to the spot contact of the next one, and so on. The lamps can be mounted in holes in a piece of board, and it will do no harm if the lamps are old and used up, so long as the filament is whole, since all that is wanted from them is resistance.

Assuming that 4 v. are needed to operate successfully the bell system, you will need 28 lamps in series. If 6 v. can be used on the system it will need only 20 lamps in series. These lamps are connected across the circuit and left on at all times when the bell system is to be working. Of course, a switch should be provided, or some method of breaking contact in case a lamp burns out and has to be renewed. There is little likelihood of a burnout, since the current passing through is very small.

From the wires on each side of one lamp take off leads and connect to the bell system in place of the battery wires.



CONNECTIONS TO BELL SYSTEM

If your bells and annunciators are where the dust can get at them you will, of course, have to go over them occasionally and get the dust out of the contacts, and all contacts and working parts should be cased in as much as possible, having one case with the bell and clapper outside and having these preferably project downward. With this protection I do not believe that the dust will cause you any trouble.

Stroke of Duplex Pump Affects Steam Consumption

N. K.—Will you kindly inform me whether reducing the slack motion between the valve stem nuts of the h. p. valves of a Worthington duplex compound pump increases or decreases the steam consumption, or can I shorten up the length of the stroke by so doing?

A.—Reducing the slack motion between the valve stem nuts of a duplex compound pump will shorten the stroke, and since this will increase the clearance of the pump, it will, of course, increase the steam consumption per horsepower. It is always advisable to run a pump as long stroke as it will stand and not make trouble.

A SIMPLE BOILER TUBE CLEANER

Steam or compressed air will effect a considerable saving in cleaning the scale from the tubes of water-tube boilers, where water is scarce, and is even more convenient than water power. Besides cleaning may be accomplished with less mess in the boiler room.

The new Weinland steam or air boiler tube cleaner, shown in Fig. 1, consists of a jointed steel shaft with a powerful cleaning head on one end and a rotary engine on the other. The only other fixtures are a supporting trolley, consisting of a rope operated differential pulley block and an overhead pipe on which it

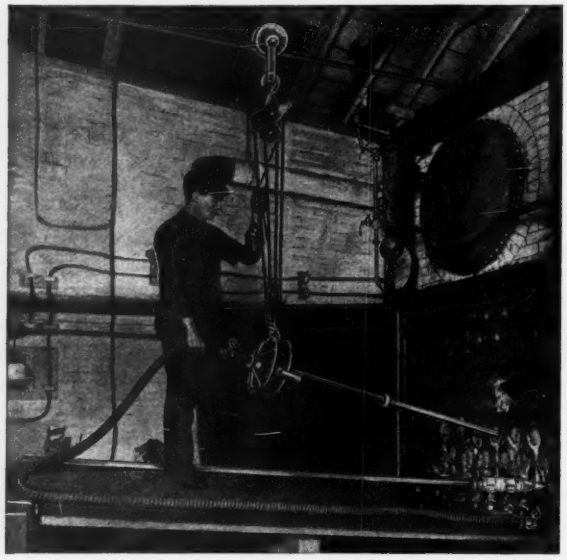


FIG. 1. WEINLAND STEAM OR AIR DRIVEN MECHANICAL CLEANER

rolls across the boiler front to align to each vertical row of tubes. The self locking rope differential between the motor and the overhead pipe offers adjustment of the motor to proper height for any row of tubes or to keep the shaft concentric with the tube axis as the head proceeds down the tube.

None of the weight of the motor is supported by the operator. The two handles are merely for guiding the machine and pushing it against the scale.

In Fig. 2 is shown the interior of the engine. Steam or air pressure enters through a hose connected on the rear side of the case, and operates against three radial paddles or pistons, thus compelling the rotor to revolve at a speed determined by the pressure of the steam and the forward thrust against the scale. The pistons are forced outward to a steam tight fit with the case by the admission of pressure at the back end of the cage in which they slide. The admission ports (3 holes near handles) admit steam to the space between the rotor and case. Each piston is under full steam pressure until the rotor has made a quarter turn, and as there are three pistons, the rotative effort is practically continuous.

The important bearing surfaces and cage in which the pistons slide are made from hard bronze and wear is further minimized by lubricators on both the front and rear of the case, which forces the lubricants to the important bearings.

Five to 9 h. p. may be brought to bear upon the scale from this machine and by throttling the steam the torque of the shaft and the speed of the cutting head may be adapted to any hardness or thickness of scale. At slow speeds and under heavy torque, the cleaner head will not become stalled in the worst scale.

When used with compressed air, the motor can exhaust direct to atmosphere, but with steam a short length of hose is attached to conduct the exhaust out of the operator's way. This cleaner, operated by steam, is about the easiest means of exerting great force against scale. All that is necessary to secure power is to connect the boiler and the inlet of the motor by hose, and turn on the pressure. This machine saves power as well as labor when steam is used, as there are no losses due to the operation of pumps or compressors.

At the Pittsburg Plate Glass Co.'s works at Crystal City, Mo., this cleaner removed from their Green Fuel economizers scale which almost filled the tubes. The scale in this instance was hard as rock, and although 3 men at times placed their whole weight on the motor the cleaning head bored its way through without stopping a single time. The cleaning head used on this machine is of the type which has been so

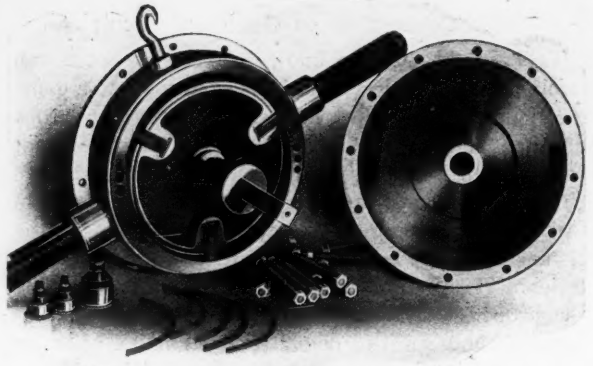


FIG. 2. INTERIOR OF ROTARY ENGINE OF WEINLAND CLEANER

successfully used in the past on other Weinland Mechanical cleaners. The screw point bores into the thickest scale, three serrated cone cutters crush the intermediate scale and the eight cylindrical cutters which follow, remove the remaining small bits and polish the tube surface.

One of the first of these cleaners was tested with both air and steam pressure at 75 lb., in the plant of the Foos Mfg. Co., Springfield, Ohio. This plant had been too crowded with business to shut down the boilers, and scale had accumulated until it was 3/8 to 1/2

in. thick and very hard. The cleaner was started at 9 p. m. one night, and by 6:30 the next morning 49 tubes had been cleaned. Many of the tubes were cleaned in from 4 to 5 min. each. Two weeks later the machine was tried on a second boiler which was in about the same condition, but in this instance compressed air was used, with equally good results.

The Weinland steam and air motor cleaner is made by the Lagonda Mfg. Co., of Springfield, Ohio.

REMARKABLE RECORD OF ECLIPSE REGULATING VALVE

High-pressure steam valves, and more especially regulating valves for reducing steam from a high to a low pressure, are subject to more or less wear, depending on the service required of them. With continued and severe service other defects are liable to creep in, and unless the valve is unusually substantial in its construction and made of the very best material, it will naturally require frequent adjustment or repairs, and prove a continual source of annoyance. In

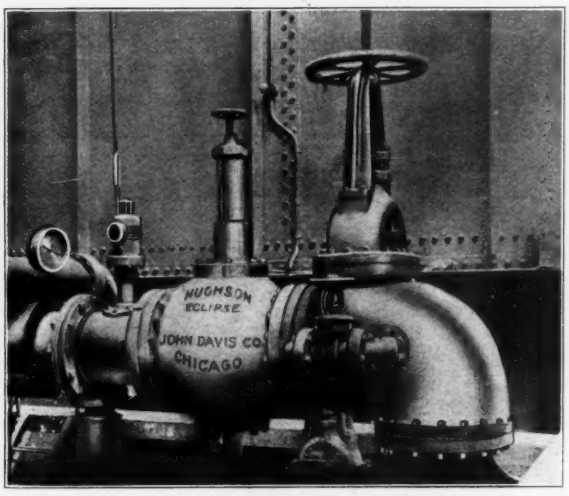


FIG. 1. HUGHSON REGULATING VALVE INSTALLED AT CHICAGO AVE. PUMPING STATION

this regard the regulating valve shown in Fig. 1 has made a remarkable record. It is of the Hughson Eclipse type, made by the John Davis Co., of Chicago, and has been in service 6 yr. at the Chicago avenue pumping station. During all this time the main valve, also shown in Fig. 1, has never had to be closed to make any repairs or adjustment on the regulating valve. In this particular instance the valve is used to reduce high pressure steam for the heating system, but may be used with equal satisfaction for any other service requiring a reduction of pressure to not less than 15 lb. Where the flow of steam is regular and where it is required that the reduced pressure be kept constant, as on engines and pumps, the Hughson is an ideal valve. A good idea may be gained from the sectional view shown in Fig. 2, and further particulars from the John Davis Co.

BUTLER'S "KLENEST" WATER GAGE

For use on boilers, tanks, receivers and like apparatus containing fluid, and particularly for installations pumping sewage or handling water containing

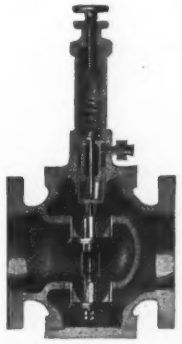
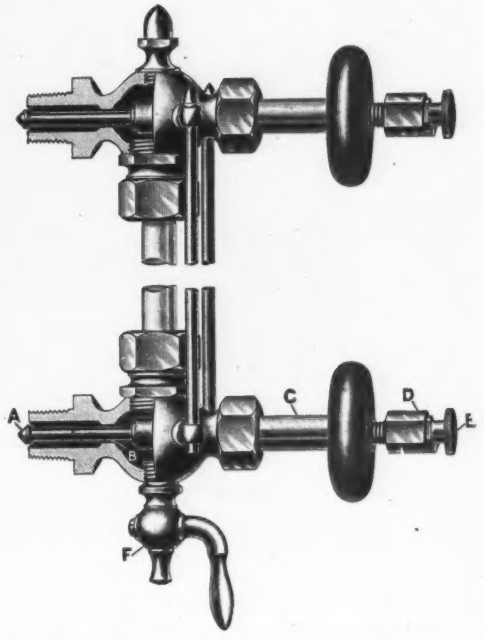


FIG. 2. SECTIONAL VIEW OF HUGHSON ECLIPSE REGULATING VALVE

much foreign matter, the water glass, shown in the accompanying illustration, has been patented by Robert Butler, 458 Meridian Ct., East Boston, Mass.

The principle feature of the device is the arrangement for cleaning out the water passages by means



WATER GAGE FITTINGS AS ADAPTED FOR BOILERS

of rods working through packing nuts on the valves. A is the head of the cleaning rod which extends through passage B, through valve stem C and packing nut D, and is screwed into the milled head E.

As will be seen from the cut, the packing nut D has a recess formed in the end into which a shoulder on milled head E fits, thereby effectively locking it and preventing rod A from being blown into the passage. To clear the passage B, turn milled head E,

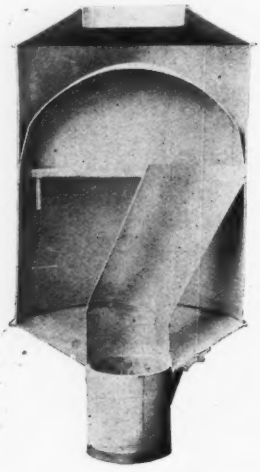
which will release it from the recess on the packing nut D, and work the rod through the passage, opening drain cock F at the same time to allow sediment to escape.

After cleaning the passage the rod should be pushed in and be locked on the packing nut, as it should remain in this position until the passage again requires cleaning. Robert Butler, 458 Meridian St., East Boston, Mass., is the maker of the gage.

THE PARKER EXHAUST HEAD

For several years the Parker exhaust head has been on the market, but a new and modified form is here shown. Instead of using the common cone form of shell, the maker has adopted a cylindrical shape, which, taken with the simple inside arrangement, makes a most efficient device. The outer shell is a cylinder, having inside a box-like arch whose spread is 3 times the intake pipe diameter. This arch is similar to what a cheese box would look like if sawed in halves across the lid and bottom, and having a gutter formed along the straight edge of the lid and bottom with drain pipes at one end.

The intake pipe inclines 60 deg. coming up under one end of the arch-shaped deflector, and in action,



SECTIONAL VIEW THROUGH PARKER EXHAUST HEAD

the steam and water sweep gently around the inner side of the arch, and escaping under both lower edges find openings greatly enlarged, when compared with the area of the exhaust pipe on their way to the air, the upper or final escapement being through an outlet from 2 to 4 in. larger than the inlet. Water and oil are separated by centrifugal force and driven down towards the drip pipe. Steam condensing against the side walls of the deflector is caught in the gutters on each side and led away by the drip pipes at the ends.

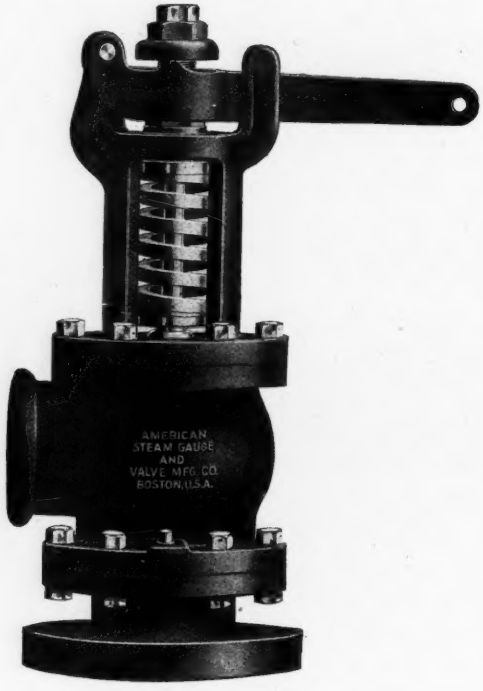
The maker claims for this head, that it is practically without friction, giving a free exhaust to the air with the least possible deflection and no sharp bends, with constantly increasing area of openings to the air, and at the same time a perfect exhaust head, completely separating the water and oil so there is no spray whatever to rot out the roof or sprinkle the pavement.

The simplicity of construction makes it inexpensive, and light of weight, easy to handle in the nearly always unhandy places where exhaust heads are located. It is manufactured by G. A. Parker, Beverly, N. J.

AMERICAN OUTSIDE SPRING POP VALVE

WITH the rapidly increasing use of superheated steam, it has become necessary to place on the market a spring loaded pop safety valve of a type suitable for the high temperature of superheated steam. To meet this demand, the American Steam Gauge & Valve Mfg. Co., of Boston, Mass., has designed a type of valve having an outside spring and constructed of metals to withstand these conditions.

The entire body and outer casing of the valve are



OUTSIDE SPRING SAFETY VALVE

made of steel. The seat bushing which guides the valve proper is made from a solid nickel casting, and the valve is also made from one solid nickel casting. The valve top or open spring casing is extended into the main body of the valve and is fitted with a solid nickel bushing which is recessed and acts as a suitable guide for the spindle. The spindle is fitted with a loose flange or spring seat having a spherical bearing, which, together with the follower or top plate, guiding the spring at the top and also fitted with a spherical

bearing, properly distributes the load on the spring, under compression, preventing undue friction of the moving parts.

The spring is made of the highest grade steel and is proportioned to give the valve the greatest possible efficiency. The American Adjustable blow down ring is used as a means of adjusting the closing point of the valve. The lifting levers may be either of the straight horizontal type or of the compound link drop lever type so proportioned as to permit the lifting of the valve from its seat one-eighth of its diameter.

AN INNOVATION IN FEED WATER HEATERS

ENGINEERS are generally familiar with the old rule of thumb that for every 10 deg. F. that feed water is heated before entering the boiler, 1 per cent less coal is required to evaporate the water into steam. Also that for each 10 deg. F. increase in feed-water temperature, the boiler capacity is increased by 1 per cent.

REILLY MULTICOIL FEED WATER HEATER

Many tables have been compiled showing the total cash savings per horsepower in plants of different types and with coal at different prices, and it is probably well within the fact-to state that there is no single piece of power plant equipment that returns a larger dividend on its investment than a proper feed-water heater, which derives its heat from exhaust steam.

Feed-water heaters in common use in stationary power plants divide themselves into four general types. First, the open heater with the exhaust steam in direct contact with the feed water; second the straight tube heater; third, the inverted U-tube heater; and fourth the pipe coil heater, usually with pipes of several different curvatures. The heater described in the following paragraphs represents a new departure in stationary power plant practice. It is the Reilly multicoil feed-water heater.

Referring to the accompanying illustration, the heater will be seen to consist of a shell of boiler plate with riveted seams and provided with a large removable door, making the interior easily accessible for cleaning, inspection or repair. At the top and bottom of the heater are headers or manifolds of cast iron, or cast steel, as required by the particular conditions, and provided with suitable flanges for the attachment of the inlet and exhaust pipes and feed inlet and outlet. Connecting these headers is a large number of small diameter, copper coils, rolled from seamless drawn copper tubing of small diameter and therefore of light gage metal. Connection between the coils and headers is made with screwed union joints ground to a steam tight fit without packing and gaskets. Brass nipples are securely brazed to each end of the coils, the joints being afterward tested to 250 lb. The number of coils in each heater depends upon the capacity required. The small diameter of the coils in the Reilly heater brings about three important results. First, the distribution of flow between the different coils is found to be almost identical, which means uniform circulation throughout all parts of the heater. Second, the violent agitation from the rapid swirling motion is of the greatest benefit in promoting the rapid absorption of heat, and third, this same swirling action prevents any deposit of scale or sediment in the tubes.

Reviewing these points in more detail. On account of the high velocity of the flow under all conditions, the slight frictional resistance offered to the water passing through the coils has proved to regulate the flow between them, because if the velocity increases even slightly, the pressure drop immediately increases in far greater proportion with the result that the flow through that coil in which this pressure drop has been caused to increase is immediately cut down until equal with the others. The Reilly Multicoil heater is designed to give a pressure drop through the heater of from 1 to 1.5 lb.

Experiments have shown that the efficiency of heating surface and the rate of absorption of heat by water are directly proportional to the extent and rapidity of the agitation of the water. Copper is about 500 times as good a conductor as water, but water in a thin film will absorb heat almost instantaneously from the walls of a copper tube. If the water be thoroughly agitated, so that every particle comes often in

contact with the heating surfaces, it would be natural to suppose that the rate of transfer of heat would be immediately increased. This proves to be the case exactly, and constitutes the fundamental principle underlying the use of small diameter copper tubing and small radius coils. In the Reilly heater the water necessarily passes through at high velocity and is violently thrown by centrifugal force against the walls of the tube in passing through the spiral, back and forth, so that there can be no sluggish central core of water.

A very simple experiment which may be performed by anyone to confirm the foregoing statements with regard to the importance of agitation in promoting the rapid absorption of heat from water from metal may be performed as follows:

A metal tube, like a piece of pipe closed at one end, should be filled with very hot water and immersed gently in a pail or basin of cooler water and allowed to remain at rest until its temperature has fallen, as measured by the thermometer, let us say, 100 deg., or to the temperature of the surrounding water. The time required for such cooling should be observed. If the same tube is filled with hot water as before, and instead of being allowed to remain quietly in the pail or basin or cool water should be stirred around and around rapidly until the thermometer shows that it has cooled down to the lower temperature, observed in the first experiment, it will be found that the time required for cooling in the case of agitation is about 1-3 the time required for cooling under the first stagnant condition. The principles involved in such an experiment are identical with the conditions outlined above in feed-water heater construction.

Reilly Multicoil Feed-water heaters are manufactured in 23 different stock sizes, from 45 up to 5,850 h. p., and it is of interest as showing the capacity of this type of heater and its small size that the diameter of the 5,850-h. p. heater is only 4 ft. 8 in. and its height between top and bottom exhaust flanges 4 ft. 11 in. This heater is made by the Griscom-Spencer Co., 90 West Street, New York City.

BELT DRESSING

There are thousands of belts standing idle at the present time in mills and factories all over the country. Nothing weakens belting quicker than to let it hang for any length of time in one position. It readily dries out and loses its pliability when not being used, and when started in operation again it commences to slip over the pulleys to such an extent that the heat generated very often bakes the surface, making it hard and slippery.

When an establishment is closed down the first thing that should be done is to relieve the belting of all strain, if possible, and give it a coating of a good preservative. There are a number of these preservatives on the market, and the outlay will be repaid in the efficiency of the belting when the plant is started again.

The F. S. Walton Co., of Philadelphia, are making an offer to send to our readers a can of Oxoil Ox belt dressing free of charge to any belt user, thus giving an opportunity to test its merits without cost. Oxoil Ox is made from the highest grade of neatsfoot oil and is therefore a splendid leather tonic, and adds new life to old and practically worn out belts, making them limber up and grip the pulleys. Mention this paper when writing, stating number and average size of belts in use.

A COMBINED SCREW FEED TUBE EXPANDER AND FLUE CUTTER

A great saving of time and increase in convenience generally results where one tool or machine can be used for more than one operation. Such is the case with the combination tool illustrated herewith, and which may be used either as a tube expander or flue cutter. This handy tool, which is made by the Ditch Adjustable Sieve Co., Mansfield, Ohio, can be quickly changed from an expander to a cutter by removing the rolls and placing in their stead the shoe containing

COMBINATION TUBE EXPANDER AND FLUE CUTTER

the rolling cutter deivce. An operator can cut a flue off in from 1 to 2 min., leaving the cut perfectly smooth, and in the best possible shape for beading. The device is made either plain, to be operated with a wrench, or with a ratchet attachment, as in the illustration.

This machine does away with the use of a hammer, and there is no backing away from the work when the machine strikes a hard spot in the flue, as the screw feed holds it in position. The rolls are made to fit the taper of the madrel, which gives them a perfect full length bearing and an even pressure on the tube.

REGULATION OF BOILER FEED

The Cope's boiler feed regulator and the Cope's pump governor are described in a booklet just issued by the American Boiler Economy Co., of Philadelphia. The construction of this device is unique and of more than ordinary interest because of its simplicity. The longitudinal expansion of a straight composition-metal tube, caused by changes of temperature, furnishes the force by which a check valve in the feed line is operated. When the water in the boiler is above the desired level the disk of this valve is held to its seat by a weight acting through a toggle joint. When the water level falls, steam enters the expansion tube and the expansion of the latter operates through a bell crank lever to raise the weight and release the check valve, permitting water to pass into the boiler. The claims for this regulator are, that it embodies only simple mechanical movements, and the fireman can see at a glance just what each part is doing.

Cope's pump governor consists of a throttling valve

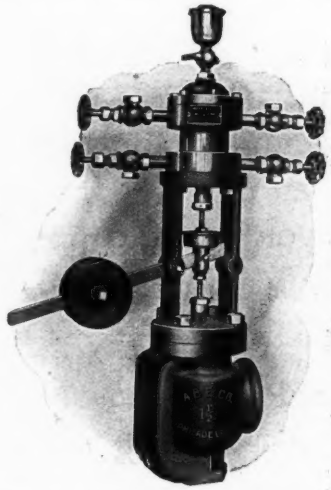


FIG. 1. COPES PUMP GOVERNOR

placed in the pump steam line and controlled by a piston on the valve stem. The pressure of water from the pump discharge acts upon one side of this piston, tending to close the valve, while steam pressure from the boiler acts on the other side, tending to open the valve. A counterweight is so adjusted that the valve will just seat when the feed line pressure is at a predetermined excess over the boiler pressure. If, for instance, there are 3 boilers in the battery and it is desired to carry a pressure, say, of 20 lb. more in the feed line than in the boilers, the controlling valve of the governor will pass steam to the pump as long as the feed line pressure is less than 20 lb. above boiler pressure. On the other hand, when the feed line pressure tends to rise above this excess, its action on top of the piston overcomes the sum of the steam

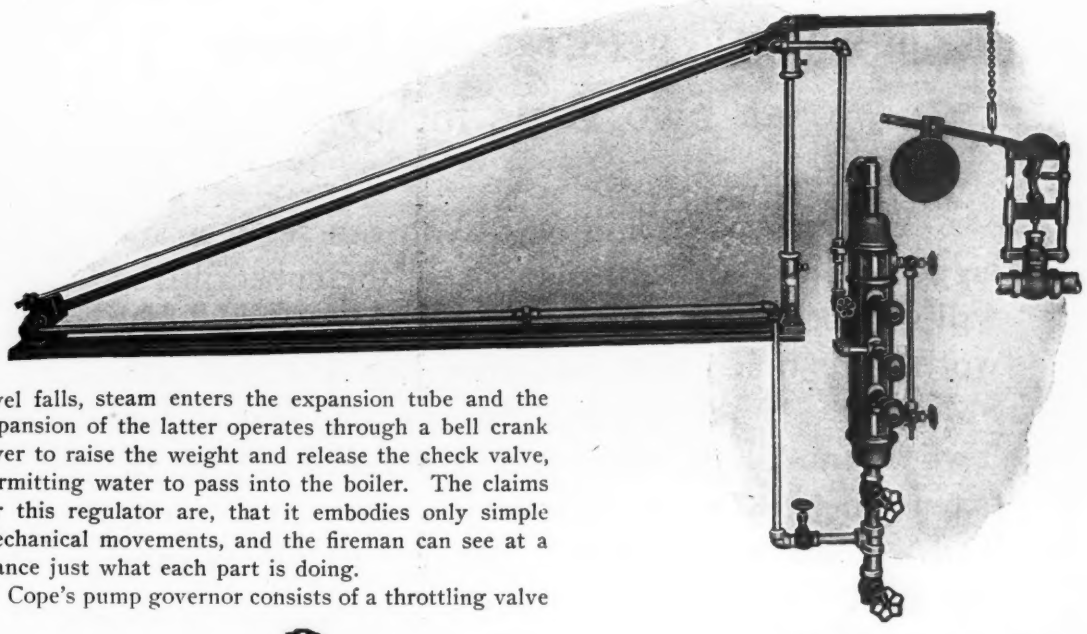


FIG. 2. COPES BOILER FEED REGULATOR

pressure and the counterweight, and cuts off steam from the pump until the pump discharge line pressure is reduced by some boiler taking water.

The advantages of a steady water level and an even pump stroke in protecting engines from water in the steam and boilers from low or cold water and in enabling heaters and economizers to recover a great amount of heat are fully explained, making it of value to interested parties, to whom a copy will be sent for the asking.

A STEAM MOTOR fire engine, recently built for service in the city of London, has a pumping capacity of 400 gallons per minute, and it can run up to 80 miles an hour on a level. The boiler is fired with oil fuel, and a supply of this, and feed water for several hours' running is carried. The wheels are fitted with solid rubber tires, those in the rear being of twin section. This engine is kept with steam up so as to be ready for immediate use.

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PRACTICAL ENGINEER

355 Dearborn Street CHICACO

NEWS NOTES

THE BUSINESS OF Wm. H. Bristol has been consolidated with that of The Bristol Co., this combination making The Bristol Co., manufacturers of the largest and most complete line of recording instruments for pressure, temperature and electricity in the world.

The business of The Bristol Co. was started in 1889 for the manufacture of two patented inventions of Wm. H. Bristol, who was then an instructor in mathematics in Stevens Institute of Technology. One of the first of Prof. Bristol's inventions was the recording pressure gauge, and these recording instruments met with such widespread success in practical service that other recording instruments for temperature and electrical measurements were soon after designed and adapted to a large number of different ranges and applications.

During the last 2 years the Wm. H. Bristol electric pyrometers and patent smoked chart recorders have been brought out by Prof. Bristol under his own name, with the co-operation of The Weston Electrical Instrument Co., which manufactures the moving elements of all these new Wm. H. Bristol instruments.

Patents on other new instruments have also been taken out, for example, on the new Wm. H. Bristol long distance electric thermometer, which has been especially designed for measurement of atmospheric and refrigeration temperatures. This electric thermometer can be used to measure the temperature at a number of distant points, a single instrument being arranged with switches to provide for this.

The new instruments are supplementary to the lines which have been regularly manufactured by The Bristol Co., inasmuch as they cover ranges and applications for which the others are not suitable.

THE NEW YORK OFFICES of the C. H. Wheeler Manufacturing Co., maker of the C. H. Wheeler Improved surface condensers, Mullan Suction Valveless air pumps, and feed-water heaters, have been moved to the Engineering Building, 114-18 Liberty Street. Charles Lang is the representative in charge.

BUSINESS INTERESTS OF THE H. W. Johns-Manville Co. in the city of Detroit and the territory adjacent thereto have increased to such an extent that a new branch is to be opened by that company. It will be located at No. 72 Jefferson Ave., Detroit, under the management of Willard K. Bush. Mr. Bush is well and favorably known throughout that section of the country, having been connected with the Milwaukee branch of the company for a number of years. A complete stock of goods will be carried at the Detroit branch, so that shipments can ordinarily be made direct from that stock.

JENKINS BROS., of New York City, has removed its Chicago store from 31-33 No. Canal St., to larger quarters at 226-228 Lake St., corner of Franklin, to accommodate the increasing business in Jenkins Bros.' valves, '96 packing and other specialties made by the company.

ACROSS THE JAMES RIVER from Richmond, Va., the Glacier Metal Co. will soon erect a new plant for the manufacture of Glacier Anti-Friction Metal, Copper-Tin Bearing Metal and other babbitt metals. The factory will be 100 ft. long by 40 ft. wide, 2 stories high, and will have a capacity of 25,000 lb. of metals a day.

ON JUNE 17 AND 18, 1908, civil service examination will be held to secure a list of men eligible for the position of draftsmen at $4 a day in the office of the surveyor general of Nevada, at Reno, two vacancies in a similar office at Helena, Mont., and such other vacancies as may occur. Examinations will be given in letter writing, arithmetic and elementary mathematics, making mechanical drawings from a rough draft sketch, public land surveying, drawing and lettering. Two days will be required for the examination. Those taking the examination must furnish their own drawing instruments and a drawing board not less than 15 in. square. Age limit is 20 years or over at date of examination. The examination is open to all citizens of the United States who comply with the requirements. Applicants should get from the Civil Service Commission, Washington, D. C., Form 1312.

IT IS GRATIFYING to note the continued demand from the far East for American machinery. Japanese industries are particularly active in this direction and within a recent period, The Westinghouse Machine Co. has booked a large number of orders through its Japanese representatives, Messrs. Takata & Co., of New York and Tokio. Outside of turbines and gas engines, the demand for vertical compound steam engines, a characteristic of Westinghouse construction, is as active as ever.

Three 500-kw. Westinghouse turbines have been shipped to the Imperial Steel Works, Japan, and to the Makkaido Tanko Steam Ship Co. The Noble School, Japan, has installed a gas engine producer plant. Four 105 h. p. compound engines go to the Tamagawa Electric Co., Japan, and to a private isolated plant in China. Other equipments have been ordered by the Acadia Sugar Refining Co. and the Yamada Hospital.

IN ORDER TO IMPROVE its facilities, the Sargent Steam Meter Co. has moved its office and laboratory to 271 to 285 East Madison St., Chicago.

MOUND TOOL & SCRAPER CO., of St. Louis, has removed to its new shop, 1606-1608 No. Broadway, where it will continue the manufacture of engineers' and machinists' tools in larger quarters and with improved equipment.

PERSONAL

THE DISTRICT OFFICE maintained by Allis-Chalmers Co. at San Francisco, in charge of H. D. Scribner, manager, has been removed from the Atlas Building to the Phillips Building, 599 Mission Street. As it is only a step from one building to the other, callers will have no difficulty in finding the new location.

D. D. PENDLETON has been appointed the Pittsburg representative of the Wheeler Condenser & Engineering Co., of Carteret, N. J., and will hereafter handle the sale of Wheeler surface pet and barometric condensers, Wheeler-Volz combined condenser and feed heater, Wheeler-Barnard water cooling towers, Edwards wet vacuum pumps, and other Wheeler specialties, such as dry vacuum pumps, centrifugal pumps, vertical engines, Wheeler vacuum pans, Wheeler multiple effect distilling apparatus, etc., in that territory.

During the past 15 years Mr. Pendleton has occupied various positions in the manufacturing, engineering and sales departments of the Westinghouse Companies, and is well acquainted with the industries of Western Pennsylvania, particularly with the designing and installation of mine power plants. His offices will be located in the Frick Annex.

FREDERICK D. HERBERT, formerly of the Allis-Chalmers Co., is now New York manager of the Terry Steam Turbine Co., with offices at 90 West Street, New York, N. Y. This turbine is used for direct connection to pumps, generators and fans, and is becoming generally used in power house work.

SOCIETIES

STATE CONVENTIONS OF ENGINEERS will be held during the summer months as follows: Pennsylvania, at Erie, June 5 and 6; Kentucky, at Owensboro, June 5 and 6; New York, at Jamestown, N. Y., June 12 and 13; Indiana, at South Bend, June 12 and 13; Ohio, at Springfield, June 18-20; Wisconsin, at Milwaukee, June 19 and 20; Wisconsin, at Milwaukee, June 19 and 20; Massachusetts, at Haverhill, July 10 and 11; Michigan, at Battle Creek, July 16-18.

SEPTEMBER 7 TO 12 at Denver will be a great week. During that time the N. A. S. E. will meet there in annual convention; there will be much of good fellowship and of serious work for the good of the association and of engineers. Also, the National Exhibitors Association will foregather to show to the delegates and visitors their wares. This means one of the best displays of power plant apparatus and supplies to be seen during the year. It means new ideas for those who see it and new friends for those who exhibit. Applications for space are already coming in. The convention meetings and the exhibit will both be in the new convention building, which is being erected for the National Democratic Convention, so that plenty of room and all conveniences are assured. Wm. D. Purcell, secretary of the Exhibitors' Assoication, 629 Market St., Philadelphia, will give further information to anyone interested.

AT ITS ANNUAL MEETING, April 30, 1908, the Technical Publicity Association elected the following officers to serve during the ensuing year: President, C. S. Redfield, advertising manager Yale & Towne Mfg. Co., N. Y.; 1st vice-president, Rodman Gilder, publicity manager Crocker-Wheeler Co., Ampere, N. J.; 2nd vice-president, C. N. Manfred, manager advertising department H. W. Johns-Manville Co., N. Y.; secretary, H. H. Kress, publicity department A. S. Cameron Steam Pump Works, N. Y.; treasurer, H. M. Davis, advertising manager Sprague Electric Co., N. Y.; members of executive committee, F. H. Gale, charge of advertising, General Electric Co., Schenectady, N. Y., and C. W. Beaver, special representative Yale & Towne Mfg. Co., N. Y. Twenty new members have joined the association since the last annual meeting.

THE ENGINEERS' BLUE ROOM CLUB, of Boston, Mass., held its second annual banquet and reunion at Revere House, on May 16. About 300 members and guests were present, completely filling the dining rooms and stirring up such enthusiasm as has seldom been seen in the sedate Hub of Massachusetts. Herbert E. Stone acted as toastmaster and was introduced by President George F. Rollins. Present as honorary guests were George H. Diman, consulting engineer of the American Woolen Co.; Jos. McNeil, chief inspector of boilers and licenses for Massachusetts; E. E. Bartlett, president of the Massachusetts Metal Trade Association, and T. M. Kelsey, past national president of the N. A. S. E. The mayor of Boston was expected, but at the last moment found himself unable to be present. Members and guests were on hand from Fitchburg, Lowell, Lawrence, Springfield, Providence, R. I., and other New England cities. The reunion was in charge of a committee consisting of Harry H. Atkinson, chairman, J. A. Merritt, G. R. Noble, A. P. Greene and H. H. Ashton.

THE SEMI-ANNUAL MEETING of The American Society of Mechanical Engineers will be held in Detroit, June 23-26. An entire session will be devoted to papers on the conveying of materials, when hoisting and conveying machinery, including belt conveyors, the use of conveying machinery in cement plants, etc., will be discussed.

Among other subjects which will be taken up in professional papers are: Clutches, with special reference to automobile clutches, by Henry Souther; Some Pitot Tube Studies, by Prof. W. B. Gregory, of Tulane University, New Orleans, La., and Prof. E. W. Schroder, of Cornell University; Thermal Properties of Superheated Steam, by Prof. R. C. H. Heck, of Lehigh University; Horse Power, Friction Losses and Efficiencies of Gas and Oil Engines, by Prof. Lionel S. Marks, of Harvard University; A Journal Friction Measuring Machine, by Henry Hess, of Philadelphia; A Simple Method of Cleaning Gas Conduits, by W. D. Mount; A Rational Method of Checking Conical Pistons for Stress, by Prof. G. H. Shepard, of Syracuse University; and The By-Product Coke Oven, by W. H. Blauvelt.

A lecture on Contributions of Photography to our Knowledge of Stellar Evolutions, will be delivered by Prof. John A. Brashear, of Allegheny, Pa. The usual receptions will be held and excursions will be made to manufacturing plants, the ship building yards and various points of interest in and around Detroit. Among the excursions planned is one to the University of Michigan, at Ann Arbor. The Gas Power Section of the Society will hold a session, and the Society for the Promotion of Engineering Education and the Society of Automobile Engineers will hold a meeting in Detroit at the same time. As far as possible, sessions will be arranged so that members interested in subjects treated by the other societies may attend their sessions without missing papers on related subjects read before the A. S. M. E.

NOTES ON EXHIBITS AT THE NATIONAL ELECTRIC LIGHT CONVENTION

IN THE BOOTH OF THE American District Steam Co., of Lockport, N. Y., one could always find a crowd of visitors. Central station managers are showing a greater interest each year in the problem of utilizing exhaust steam for heating and recognize the many advantages of the system of this company, who are pioneers in the work.

A model of an underground steam line was shown; also a full line of Angle Fittings, of which they make a specialty.

In attendance were Robert Hall, treasurer of the company; H. C. Eddy, manager of the Chicago office; H. C. Kimbrough, H. G. Luckerman and J. A. Bendure.

THE ALLIS-CHALMERS CO., Milwaukee, Wis., had an exhibit representing all of the standard power and electrical machinery which it manufactures, including every type of prime mover, generator, motor and auxiliary apparatus. The company's new line of type K motors for direct current, and type AN induction motors for alternating current were particularly prominent. The exhibit was in charge of C. A. Tupper, and a large number of the officers and salesmen of the company were in attendance. These included President W. H. Whiteside, W. S. Heger and M. C. Miller, assistants to the president; A. H. Whiteside, manager of the steam and electrical department; E. T. Adams, manager of the mill and gas engine department; B. A. Behrend, chief electrical engineer; James Gardner, Chicago, district manager; and S R. Kerr, C. S. Buell, Ervin Dryer, J. M. Dennison, D. K. Chadbourne, H. I. Keen, A. W. Catlin, Charles M. Howe, O. F. Russell, T. B. Whitted, R. H. Gaither, C. M. McDonald, R. B. Williamson, L. E. Bogen, David Hall, B. Frankenfield, H. L. Watson, J. S. Jackson, J. S. Vrabek, D. H. Kelley, J. M. Kingsbury, W. G. Hammond,

G. S. Burdick, R. D. Tomlinson, Percy A. Himes, D. P. Davies, L. C. Marburg, C. E. Lord, Willis Collins, A. P. Peck, Harry Byrne, S. Gibson and C. A. Shearer, engineers and salesmen of the company.

H. W. JOHNS-MANVILLE Co. exhibited a complete line of its electrical products—consisting of fuses, service boxes, insulators, Victor combination meters, linolite and asbestos wood. The following representatives were in attendance: J. W. Perry, R. B. Hatch, H. M. Frantz, Geo. Saylor, F. C. Frumvreller, T. G. Younglove, H. W. Frantz, J. C. Younglove, Frank Gilmore, Bailey Whipple.

AN INTERESTING EXHIBIT of the Fort Wayne Electric Works, of Ft. Wayne, Ind., included a full line of fan motors and meters. F. S. Hunting, sales manager, and A. A. Serva, asistsant sales manager, were busy entertaining many visitors, and were ably assisted by W. S. Goll, T. J. Ryan, L. A. Carr, W. K. Eicher, A. L. Pond, M. J. Hine and W. C. Knight.

THE BOOTH OF The General Electric Co. was trimmed in green and furnished in mission furniture. It was illuminated with Tungsten lamps of various candlepower and various shape of Holophane reflectors, and with an installation of series Tungsten lamps for street lighting.

The General Electric people have been spending considerable time developing a new aluminum cell lighting arrester which was shown for the first time. Another interesting device which is in extensive use for charging automobile batteries was the mercury rectifier.

Among the laboratory instruments made by this company, in response to the increasing demand for devices of this general character, is the Oscillograph, which was exhibited in operation, showing the wave form for a small generator. Cooking and heating devices occupied a considerable part of the space, among them a number of new devices presented for the first time.

Representing the company at the convention were: J. R. Lovejoy, vice-president; J. W. Johnson, manager Chicago office; C. B. Davis, manager Boston office; Theo. Bevan, manager New York office; W. L. R. Emmett, engineer, storage battery department; Frank H. Gale, in charge of advertising department; D. B. Rushmore, engineer motor department; A. D. Page, manager incandescent lamp sales; F. N. Boyer, assistant manager Chicago office; D. R. Bullen, manager supply department; A. D. Babson, New York supply manager; H. C. Houck, Cincinnati supply manager; G. L. Thompson, Philadelphia supply manager; G. A. Wooley, Denver supply manager; T. E. Bibbins, San Francisco supply manager; F. G. Vaughan, manager meter sales; E. E. Gilbert, manager turbine sales; G. F. Morrison, manager lamp works; W. D'A. Ryan, C. B. Burleigh, I. H. Livsey, H. T. Buddy, Geo. D. Rosenthal and C. W. Stone.

THE WESTINGHOUSE EXHIBIT showed its heating apparatus. Into this field recently entered the acquisition of the Hadaway Electric Heating & Engineering Co., formerly of New York. The apparatus that was exhibited in this line was from regular stock, and comprised a 2-qt. glue pot, goose irons, sad irons and a veluring stove, such as is extensively used in the finishing of silk hats.

A full line of Westinghouse arc lamps was on display, as well as fan motors, including 16 in., 12 in. and the latest style of 8-in. fans, with a full line of current measuring instruments for switchboards, meters and portable electrical instruments.

The exhibit was lighted by Westinghouse Tungsten lamps around the exhibit and on a revolving wheel.

The following representatives were in attendance for The Westinghouse Electric & Mfg. Co.: C. S. Cook, manager Railway & Lighting Sales Dept.; S. L. Nicholson, manager Industrial & Power Sales Dept.; C. B. Humphrey, manager Detail & Supply Sales Dept.; G. B. Griffin, assistant manager Detail & Supply Sales Dept.; H. P. Davis, assistant chief engineer; T. P. Gaylord, manager Chicago office; J. A. Breet, manager Cincinnati office; C. F. Medbury, manager Detroit office; C. E. Miller, manager Cleveland office; also W. P. Jend, G. M. Bates, Samuel Chase, W. B. Wilkinson, E. T. Penrose and S. Q. Hayes.

For the Westinghouse Machine Co.: C. C. Chapelle, manager Chicago office, and J. R. Bibbins, of the Pittsburg office. For the Westinghouse Companies' Publishing Department, J. C. McQuiston, manager.

TRIUMPH ELECTRIC Co., of Cincinnati, exhibit consisted of a line of motors and auto-starters for induction motors. W. H. Jacob, J. C. Hobart, C. S. Renolds and S Senstius were in charge of the exhibit.

"WE'RE HERE BECAUSE WE'RE HERE," was the motto of H. M. Post, in charge of the exhibit of the Western Electric Co. Tiny red pennants fluttered in the breeze of electric fans which were fastened at each corner of the booth. Various types of arc lamps formed a part of this exhibit, one of the most interesting of which was the Truing Indicator lamp, which had a device by which it automatically informed its possessor when it was time to trim it.

One of the decidedly novel features in the booth was the intercommunicating telephone, especially adapted to making connections between the switboard room in central stations and boiler and engine rooms. No indicator is required—you simply touch the button and the telephone does the rest.

All of the Western Electric Co.'s sales managers were in attendance at the convention, and Mr. Post ran automobiles between the Hawthorne works and Chicago every hour during the day.

THE CROCKER-WHEELER Co. exhibited a lighting transformer, small induction motor, a Form L DC motor and arc lamps. Heretofore the company has made its chief offering to the central stations in the line of direct current generators, alternating current generators and its celebrated line of Form L direct current motors. It now takes its place as a supplier of alternating current and direct current motors and transformers of the high C-W standard. Julian Roe, Chicago manager, William F. Sullivan, Hugh A. Brown, Herbert E. Kerber and Rodman Gilder, manager of the advertising department, were in attendance.

BOOK REVIEW

ENGINEERS' DESCRIPTIVE CHARTS, by Joseph G. Branch, Chicago, 1908. Mr. Branch is well known to engineers as the author of several works on power plant subjects and these latest products of his pen are as interesting and instructive as the books have been. The charts are four in number, three of the Engineers' Descriptive Charts and a Fireman's Chart.

The first chart shows the development of the steam boiler by means of 8 3-color plates, beginning with the Newcomen boiler and tracing the development down to the modern fire-tube and water-tube types. Besides the illustrations the chart contains questions and answers showing the faults of each type of boiler and how these faults were remedied in the next type which was developed. The second chart shows the development of the steam engine, beginning with the Hero engine, 120 B. C., and showing the different stages down to the steam tur-

bine. This chart is also in colors, and with each of the illustrations are questions and answers showing the method of working of the type of engine illustrated and its advantages over the preceding type. The third chart shows the development of the electric generator from the elementary experiments by Oersted and the complete modern dynamo. The text in connection with the illustrations shows the development of the theory of the dynamo by means of the experiments which Faraday performed in working out that theory. In the Fireman's Chart, which is also a guide for smoke prevention, proper and improper methods of firing a boiler are shown, the cause of smoke is explained and rules given for firing a furnace so as to prevent smoke.

All of these charts are printed on a tough, heavy paper with ornamental border and with metal binder at top and bottom so that they can be hung on the wall of the engine room for quick reference and study.

FIVE YEARS' QUESTIONS AND ANSWERS, Volumes 1 and 2, is the title of a book issued by the National Association of Stationary Engineers, and which contains a large part of the work that has been done in the meetings of the various associations during the last 10 years. The volumes are supplied with a good index so that questions on different subjects may readily be found. At the back of the book are given a number of tables of values to complete the usefulness as an engineer's reference book. The subjects treated in this book are as numerous as the kinds of apparatus to be found in a power plant and the problems to which answers have been given are such as arise in every-day practice in the engine room. The price of this book, which contains 339 pages, is $2.

WEINLAND BOILER TUBE CLEANERS are now being furnished with a new type of head which promises greater efficiency than possible with the former construction. The prominent feature of this Weinland Wing Head, as it is called, is the large number of cutter wheels swinging on crosswise arms and so mounted that the cutting wheels attack scale simultaneously in 3 different sections of the tube. Each arm works entirely independent of the others, so that the general effect is that of a number of cleaners all operating at once. The forward arms are provided with conical cutter wheels in front, each of which is followed by three star cutters mounted on the same shaft. The second, or rear arms contain 3 cutting stars each, and finish the cleaning operation by removing the last particles which may have escaped the forward wheels. It will thus be seen that as each pair of cutters revolves in a different path a large surface is being cleaned at one time and as the cleaner travels, the scale surface is successively attacked by the separate sets of cutters. Numerous tests of the new type of head prove that it works faster than the older type, and that it removes scale more thoroughly without injuring the tubes. The cone and star cutters are the only parts subject to much wear, and they may be replaced for practically nothing. The arms and pins are all hardened steel and made extra heavy, both to add strength and to give more power.

A specially compact head with universal joint is made for cleaning curved tubes and special sizes are made for each size of straight tubes.

The Weinland ball and thrust bearing cleaners equipped with the wing head are fully described in a new 36-page catalog which will be sent by the Lagonda Mfg. Co., Springfield, Ohio, to those interested.

LUNKENHEIMER CO., of Cincinnati, has just issued its 1908 illustrated catalog and price-list. As always, this book is full of information which is useful to the engineer and is the handiest kind of a reference when ordering supplies for new installations or repairs for piping. The completeness of the line of specialties listed is shown by the alphabetical index, which takes up 13 closely set pages. The book itself contains 564 pages, part of which is useful information and tables, directions for erecting steam piping, and other engineering operations. The rest of the book gives illustrations, description and price-list of the Lunkenheimer products, which include valves of all descriptions, water columns, whistles, cocks, flanges, injectors, locomotive specialties, oil pumps, grease cups and special oilers.

THE LARGEST AGGREGATION of the most powerful steam engines in the world furnishes the power to operate the New York Subways, the greatest work of its kind ever undertaken. The test of these engines is described in Allis-Chalmers Co.'s Bulletin, No. 1502, a copy of which can be had upon application. Each engine is rated nominally at 8000 h. p., but its actual capacity is 12,000 h. p. The power plant, consisting of 9 engines, is equal to the power of 6 such vessels as the Connecticut, flagship of the new Pacific fleet, with 4,500 h. p. to spare. The combined engine power of 3 or 4 leviathans of the deep, like the Kaiser Wilhelm II., the Oceanic, and the new turbine steamers built for the Cunard line, would be required to equal the power of the New York Subways. Measured in electrical terms, the daily average output of the 9 engines is about 800,000 kw. hr. Roughly, this is equivalent to 1,250,000 h. p. exerted for 1 hr. One thousand tons of coal and 1,800,000 gal. of water, or enough to supply the needs of a city of 30,000 to 40,000 inhabitants are required daily. Naturally the outcome of a test of an installation of this magnitude is of universal interest.

WEBER GAS ENGINE CO., to show the reliability and durability of the gas engine and producer, has just issued brochure No. 57, which illustrates an electric light plant that furnishes the street and commercial lighting in a small town of about 1,000 inhabitants. It tells of how, when financial failure was staring this plant in the face 3 years ago—due to the lack of economy of its steam power equipment—a Weber gas power plant was installed, and of the striking performance of 1 1/5 lb. of coal per brake h. p. hr., including standby losses, with never a single shut down or interruption in the service. Repairs have been less than $5 and the plant has paid a comfortable dividend each year. Gas power has made it possible, practical and profitable for very small towns to have the modern convenience of electric light and power. Readers can have a copy of this brochure and a fine catalog upon request to the Weber Co. at Kansas City.

FROM THE PRESS of the H. W. Johns-Manville Co., Advertising Department, has just been issued a pamphlet entitled Practical Sound-deadening and Weather-proofing. The pages of this booklet are devoted to explaining the advantages of Keystone hair insulator and to illustrating the applications of this material as a deadener and as means of keeping out the cold and dampness. The booklet may be obtained from the H. W. Johns-Manville Co., 100 William St., New York City.

A DIRECTORY TO THE PARTS of a Corliss Engine is a good name for the Engineer's Twin City Corliss Book, issued by the Minneapolis Steel and

Machinery Co. In it are given key numbers to each part of the engine, even to the smallest detail, and a list of the names of these part according to numbers. In addition, directions are given for Corliss valve setting, tables of sizes and horsepowers at various pressures, both simple and compound condensing, coal consumption, power of belts and shafting and of rope drives. It is a good book to own and is attractive in its make up as well as useful.

MODERN STEAM SPECIALTIES are explained in a catalog issued by Kieley & Mueller, 34 West 13th St., New York City. They have placed several new specialites on the market, among them an extra high-pressure reducing valve, nonreturn stop and check valve, new steam trap, outside air dash-pot back-pressure and relief valve, hot water temperature regulator, new grease extractor and muffler tank, and feed-water heater. In addition to these new devices they manufacture other specialties, as follows: Reducing valves for all purposes, steam traps, damper regulators, steam separators, grease extractors, pump regulators, water pressure regulators, water feeders, high-pressure boiler feeders, feed-water regulators, grease and oil traps, water arches, high and low-water alarms, strainer connections, drip tank controllers, float valves, pump governors and receivers, combination muffler and grease extractor, grease extractor and purifier, and waste heat utilizers, all of which are described in the catalog and circulars.

ALLIS-CHALMERS CO., Milwaukee, in Bulletin No. 1611, describes in full the 39th Street Pumping Station at Chicago, which is equipped with centrifugal pumping units mounted on vertical shafts and driven on the upper end of the shaft by triple-expansion engines having the three cylinders located at 120 deg. to each other. The plant is for the pumping of water and sewage into the sanitary canal channel and has a capacity of 2,160,000,000 gallons a day. The bulletin describes the station fully and gives illustrations, both by photographs and line drawings of the arrangement of the station and the machinery there installed.

CROCKER-WHEELER CO., Ampere, N. J., distributed at the convention of the National Electric Light Association in Chicago an interesting account of the new power plant on the Chicago Drainage Canal at Lockport. The bulletin is No. 103 of the Crocker-Wheeler series.

UNIVERSITY OF ILLINOIS has recently completed a series of experiments at the Engineering Experiment Station on the strength of chain links, report of which is made by G. A. Goodenough and L. E. Moore in Bulletin No. 18 issued by the university. This gives in full a description of the methods of testing, results obtained and the formulas derived from these results. It is a work in which mathematics is frequent and is for the man interested in investigations rather than the practical worker. The book contains 73 pages and may be had on application to the university.

DART'S PATENT UNION with bronze to bronze spherical seats are cleverly shown by a dodger the shape of the union, which opens to show a sectional view on the inside. This is sent out by the E. M. Dart Mfg. Co., of Providence, R. I.

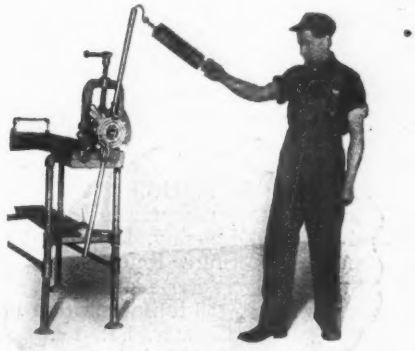
HOHMANN & MAURER MFG. CO., of Rochester, N. Y. sends out an attractive desk calendar with thermometer mounted on it which is a facsimile of the encased thermometers used for measuring the temperatures of liquid flowing through pipes and which are manufactured by this company.

WILLEY ELECTRICALLY DRIVEN TOOLS are fully illustrated and described in a handsome catalog just issued by James Clark, Jr., Electric Co., of Louisville, Ky. This firm manufactures dynamos, motors and electrically driven machine tools, among the latter being hand drills, press drills, portable drills, grinding machinery of different types, multiple spindle drills, radial drills and other similar shop tools. The catalog is printed on a heavy enameled paper and has 43 pages of description and illustration.

TRADE NOTES

AMONG RECENT SALES in the line of steam specialties The Ohio Blower Co., Cleveland, Ohio, reports the following: To the Tower Hill-Connellsville Coke Co., Uniontown, Pa., 2 12-in. cast-iron exhaust heads, 1 5-in. horizontal separator, 2 10-in. horizontal separators; Ellingsburg Washington Normal School, Seattle, Wash., 1 exhaust head; Lee-Huckins Hotel Co., Oklahoma City, Okla., 1 10-in. exhaust head; Merchants Ice and Cold Storage Co., 1 5-in. horizontal steam separator; Knott-Van Arnam Mfg. Co., Fort Wayne, Ind., 1 6-in. horizontal oil separator. Also a number of ammonia separators for use in connection with ice manufacture.

THE OSTER ADJUSTABLE DIE STOCK is no experiment, but has been tried for 15 years; the new features which have recently been developed keep it a leader among adjustable stocks. These are the ingenious design of the dies, and placing them in the



body so that all sizes from 1 to 2 in. are threaded without change of dies. Therefore, as the guides are adjustable to all these sizes, the tool is self contained, and not a single extra part or loose bushing is required to do the job. By long experience and careful experiment, the dies have been developed into perfect cutters which shave the metal out of the thread, reducing the strain so that the dies start with a pull of only 12 to 14 lb., and finish with a total expenditure of energy amounting to only 210 foot-pounds. This is the total of strain measured on each turn of the die until the thread on 2-in. pipe is completed, and is almost 1/3 less than the result shown by actual tests of other die stocks. This die stock is made by The Oster Manufacturing Co., Cleveland, Ohio, which has issued a new complete and attractive catalog.

S. J. PECK, SUPERINTENDENT of the City Light and Water Plant, Oxford, Ind., writes to The

Buckeye Boiler Skimmer Co., Toledo, Ohio: "We presume you would like to know what results we have had with your skimmers, which we purchased 60 days ago.

"We have 2 72 by 16 boilers, and before installing your skimmers we could not run either boiler more than 4 or 5 days without changing over and washing out, our water being strongly impregnated with magnesia and lime. Now we only wash out every 2 months, and could run them longer only we open up the boilers to take out the old scale, which the contraction and expansion of the boiler is loosening, and cleaning shell and tubes in nice shape. It is certainly a success, as it is always "busy" when the boiler is working. Wishing you the success you deserve."

YORK MANUFACTURING CO., manufacturers of ice making and refrigerating machinery, York, Pa., has made recent sales to the following firms: Rochester Packing & Cold Storage Co., Rochester, N. Y., 1 65-ton refrigerating machine and direct expansion piping; Davidson Heating & Construction Co., Hanover, Pa., 1 2-ton refrigerating plant for Schmitt Bottling Works; Karl Vesterdahl & Co., New York City, N. Y., 1 10-ton refrigerating machine; White Hall Ice Co., White Hall, Ind., 1 complete 10-ton ice making plant; Pennsylvania Engineering Co., Philadelphia, Pa., 1 10-ton refrigerating machine for Y. M. C. A. building, Philadelphia; Alois Bube Brewing Co., Mt. Joy, Pa., 1 40-ton compression side; Hamilton & Robinson, Mexia, Texas, 1 complete 40-ton ice making plant; C. B. O'Donnell, Jr., Vincennes, Ind., 1 20-ton compression side, 5-ton ice making plant and piping for cold storage; Robert F. Mackenzie Co., Cleveland, Ohio, 1 10-ton refrigerating plant; Mohican Co., Syracuse, N. Y., 1 6-ton refrigerating plant for their Syracuse stores; City Ice & Power Co., Bay Minette, Ala., 1 complete 10-ton ice making plant; Fred P. Lutz, Steubenville, Ohio, 1 10-ton refrigerating plant for slaughter house; Brewster Hotel, Boston, Mass, 1 10-ton refrigerating plant; Minnesota Creamery & Grocery Co., Minneapolis, Minn., 1 10-ton refrigerating plant; New Vendome Hotel, Evansville, Ind., 1 3-ton refrigerating plant; J. Y. Griffin & Co., Winnipeg, Manitoba, one 90-ton compression side; Michigan Agricultural College, Lansing, Mich., 1 1-ton refrigerating plant; Ohio State Reformatory, Mansfield, Ohio, 1 10-ton refrigerating plant; Tide Water Oil Co., Bayonne, N. J., 1 150-ton absorption plant; Consumers Ice Mfg. Co., Chester, Pa., 1 60-ton freezing and distilling system; Gottfried Brewing Co., Chicago, Ill., 1 50-ton freezing and distilling system.

MAIB & CO., of Louisville., has received from Royal Spring Ice Co., of Georgetown, Ky., a most flattering letter, as follows: "After trying several of the most expensive and most highly recommended packings on our ammonia pumps, and failing to get results from their use, we were induced by your Mr. Craft to give your Ambest packing a trial under a guarantee. We did so, but after our previous experience expected it to fail also, but we have been most agreeably surprised at the results obtained by its use, having used it for the past 2 months, and there has never been the least trace of a leak, while our weekly expense heretofore for packings for these pumps was more than the initial expense of the Ambest, not to mention the loss from ammonia leakage." This packing is made by Canfield Manufacturing Co., Philadelphia, Pa., who will send further information.

DURING JANUARY, the Duquesne Steel Foundry, which operates a large plant in the Pittsburg district, decided to adopt the gas power system to operate the works formerly driven by steam. The initial equipment will consists of a 400-h. p. Westinghouse gas engine of the 3-cylinder vertical enclosed type, direct connected to a 240-kw. generator which will serve the various motor drives around the plant. The plant will operate on natural gas, which is available in large quantities in the Pittsburg district for power as well as lighting, at such low rates as to render gas power the cheapest form available in this section of the country.

JUST AT THE CLOSE of 1907, one of the largest orders ever placed for mechanical stoking equipment was received by the Westinghouse Machine Co., aggregating 14,400 boiler horsepower.

WISCONSIN ENGINE CO., of Corliss, Wis., has begun the manufacture of gas engines and is now prepared to supply installations in units up to 5,000 h. p. of gas engines, high duty Corliss engines and pumping engines.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

PATENTS

Watson E. Coleman, Patent Attorney, Washington, D. C. Advice and books free. Highest references. Best services. 4 tf

WANTED

Engineers, Firemen, Electricians, Machinists, etc. New 25-page pamphlet containing questions asked by Examining Boards sent free upon request. Address, Geo. A. Zeller Book Co., 4467 W. Belle Place, St. Louis, Mo. Established 1870. 4 tf

FOR SALE OR TO LET

An up-to-date flour mill to let or for sale. New and up-to-date machinery, Corliss engine, new water-tube boiler. heater, pump and everything to economize operation; also has water power right and chopping outfit. Capacity about 60 barrels per day. Will sell for $10,000 or rent for $1,000 per year. Address The Linder Shoe Co., Carlisle, Pa. 5-1

POSITION

Engineer wants position as hoisting engineer, cableway preferred. Sober and can give references. State wages. Address Ben Mast, Greentown, Ind. 5-2

POSITION

An engineer, thoroughly experienced with steam and gas engines and with lighting plants, wants position. West preferred. Address A. Lykke, Grand Island, Neb. 5 2

ENGINEERS AND MECHANICS

to make big money selling Incomparable "Dozit" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Co., 225 Congress Street, Boston, Mass. 4 tf

FOR ENGINEERS

The new revised edition of the Modern Engineer's Hand Book. A $2.50 Book by mail on receipt of 50 cents. Be quick. Address, W. H. Ermentrout, 514 Elm Street, Reading, Pa. 4 tf

PATENTS

C. L. Parker, Late Examiner, U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 Dietz Bldg. Washington, D. C. 4 tf

FOR SALE

60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

SALESMAN

We want a good Salesman in every city in the United States, to handle Ideal Metallic Packing. Manufacturers' Agents and Engineers, preferred—Ideal Metallic Packing Co., South Stillwater, Minn. 4 tf